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(Agenda Item II (a) ii)

Prepared by FAO as UN Interagency focal point with contributions
from Unesco and WHO.

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UN CONFERENCE ON THE HUMAN ENVIRONMENT

STOCKHOLM 1972

DRAFT

FORESTRY 1/

Agenda Item II (a) ii

1/ This draft basic paper was prepared by FAO as UN Interagency focal point with contributions from Unesco and WMO.

FORESTRYSUMMARY AND RECOMMENDATIONSI. SITUATION AND PROBLEMS

The paper begins with an appraisal of the world's forest resources from the environmental point of view. The various types of forest vegetation in the various ecological zones of the world are described.

It is pointed out that because of increasing populations and rising standards of living, the demand for those goods and services which the forests provide is rapidly growing. As a consequence, the forests in many countries have been unscientifically exploited and substantially reduced. Moreover, in some areas, for reasons not directly connected with production, forest vegetation has been destroyed by combustion products such as sulphur dioxide.

This unplanned destruction of the forests is regrettable because forests are the greatest achievement of ecological evolution. They are the largest, most complex, and most self-perpetuating of all ecosystems. It is in forests that natural regulatory processes excel, producing the most stable of all ecosystems. It is in forestry that man has the best opportunity to work with nature. The principles of ecological succession, their application to the dynamics of forest ecosystems, and the concept of a culminating stage allowing for maximum protection from perturbation are discussed. Attention is also drawn to those features of the environment which make forests particularly vulnerable to man's action. The role of the forest in conserving and enhancing environmental quality at both the global and local levels is therefore thoroughly examined at this stage.

However, although the environmental role of the forests is of great importance, forests have other functions. In particular, forests may be used as a basis for industrial development. Indeed, because of the special characteristics of wood as a raw material, the wide range of end products which are derived from wood, the high linkage effects which are engendered in the various types of wood processes, and the importance of wood and wood products in international trade, forests and forest industries have come to be regarded as being of special importance in the attack on economic underdevelopment.

Environmental problems may arise through the exploitation of forests and the industrial use of its products. For example, soils may be compacted, erosion may occur, and water regimes may be upset. In addition, noxious fumes from forest industrial installations may pollute the atmosphere, and water supplies may become relatively impure through the release of effluent from industrial plant.

Many of the things which need to be done to prevent or to eliminate these adverse effects on the environment are known: the adoption of special forest management practices in certain types of forest areas, plant siting, plant design, waste disposal, waste utilisation, process modification, etc. However, the improvement or maintenance of environmental quality almost inevitably increases the costs of forest exploitation and of the industrial processes. This may be of serious consequence to the developing countries, for increased costs may well weaken their competitive position with regard to the industrialized countries. On the other hand, overcoming the pollution problem in the developed countries may involve a radical re-structuring of their institutions.

In addition to the utilization of forests for the production of wood and wood products, the forests are used in many developing countries for grazing and shifting cultivation. In such cases they are often regarded as obstacles to development. One way of reconciling these conflicting demands of the farmer and the forest conservationist is through the preparation and implementation of proper land-use plans. Guidelines for such plans are presented. An attempt is also made to quantify the present situation and trends with regard to the demand for timber, grazing, recreation, and other environmental values.

II. POLICY GUIDELINES AND RECOMMENDATIONS TO GOVERNMENTS

The second section of the paper begins with a brief discussion of the management of forests in relation to the environment. In addition to the classical methods of forest management, it is emphasized that forests can be managed to meet either single objectives or a multiplicity of objectives. The flexibility of forests, their dynamic nature, and the often compatibility of management objectives suggest that multiple use management and the associated modifications of silvicultural practices are feasible. The several ways of applying multiple use management, and the relevance of particular systems to particular types and structures of forests are discussed.

Attention is then drawn to the possibilities of establishing man-made forests either to replace forests which have been exploited or to afforest bare ground or land formerly under some other type of land-use. The special ecological characteristics of these types of forests and the contribution they are capable of making in enhancing the human environment are presented to governments.

A plea is then made to governments to define or up-date their national forest policies and plans so as to take into account the growing concern about the environment and the demands for social services which are increasingly being made on the forests. Governments are also urged to make the institutional changes necessary to implement these policies. In particular, comprehensive legislation should be enacted, their forest administrative machinery re-structured, and their personnel trained and educated in such a way that they become conscious of the inter-actions of the various factors of the environment.

Governments are also advised to establish environmental planning authorities at national and/or provincial, state or local level. The main functions of these authorities would be to assess environmental values and to evaluate specific development projects by making "impact surveys" in advance of project implementation. These surveys would identify all the environmental components that may possibly be affected by the project; determine the effect of proposed developments on each component; and recommend the appropriate measures to guarantee that environmental changes brought by the project are held within reasonable limits.

It is also recommended that urban planning commissions seek the advice of environmental foresters in establishing tree gardens and plantations to improve the appearance of the urban landscape and reduce noise pollution.

III. ACTION PROPOSALS TO GOVERNMENTS AND UN AGENCIES

The final section of the paper is devoted to proposals for action at the international level. The first two of these proposals are new, the others are an expansion and refurbishing of on-going activities.

Because of the beneficial influence of forests on the total environment, a World Forest Appraisal programme is proposed. Through the programme, the world's forest cover would be continuously monitored. This would provide an indicator of global environmental stability. In particular, the balance between the world's forest biomass will be continuously measured, the quantity and quality of forest areas assessed and classified into relevant ecological groups, and changes in the forest biomass which it is considered may have a significant effect on the environment will be recorded.

Data will be collected by remote-sensing techniques, through national reports, and by scanning existing inventories. The information would then be collated, analysed and computerized. An effective model would be constructed, from which caution and danger areas would be identified, and an alarm system organized for warning governments. Where, for example, the world's thermic balance is altered by the destruction of forest areas, the programme would be in a position to recognize this phenomenon and to advise on extensive afforestation or reforestation schemes.

The programme would also coordinate information on forest destruction through fire, and research on the service and technology of forest fire prevention and control. An important feature of the programme's activities would be the detection and location of spontaneously occurring forest fires.

Another programme which is proposed is designed to promote institutional innovation in the field of environmental forestry. Such a programme would include (a) comparative studies on the influence of land tenure systems on the protective and recreational role of forests, (b) the development and codification of an international text related to forest protection, (c) research on the development of public administration for environmental forestry, and (d) the revision of current education and training programmes to accommodate new techniques for forest resource management.

The third proposal for action at the international level concerns the coordination of international research on the influence of forests on the environment. The object of this exercise would be to launch an International Research Programme which would deepen and expand our knowledge of forest ecological influences. The Programme would also define and standardize the criteria and methodology for the evaluation of forest influences in economic terms.

The final proposal is to institutionalize, under an international organization, international exchange of information on forest industries pollution control. Technical and economic data on the level of pollution caused by forest industries and on the control measures needed to secure adequate protection from such pollution would be collected by this organization and distributed to governments and industries.

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INTRODUCTION

The forest has been a feature of man's environment from time immemorial - taken for granted, sometimes preserved, more often cleared. It has provided many of his basic needs, shelter and water, food from wild animals, protection for his crops.

In modern society the products from the raw material of the forest have become more and more sophisticated. Still the forest, until quite recent times, has been regarded as limitless, because renewable. It is only in the last 25 years in fact that the rate of disappearance of the world's forests has been recognized as an imminent danger to the whole environment.

As far as the forestry profession is concerned, this recognition of the multiple functions of forests, of the influence of forests on the quality of the environment at both the local and global levels, was first given widespread publicity at Seattle in 1960 at the Fifth World Forestry Congress. It was given further emphasis at the Sixth Congress in Madrid in 1966. Over the last decade or so it has been the subject of much study and research. As a result, our knowledge of the inter-relationships of the forests with other factors of the environment is tending to become more precise.

In this paper the distribution of the world's forests is described, the nature of the forests ecosystem examined, and the influence of forests on environmental quality evaluated. The ecological problems which might arise in clearing forests for agriculture, in exploiting the forests for wood, and the industrial processing of wood products are identified, and suggestions are made for their resolution.

Finally certain policy guidelines with regard to the management of the forest estate and the control and regulation of forest industries are suggested to governments, and recommendations are made to the International Agencies. These recommendations include the establishment of a forest monitoring system to act as an indicator of global environmental instability, the coordination of research on the influence of forests on the human environment, the formulation of a programme designed to promote institutional innovation in the field of environmental forestry, and international exchange of information on forest industries pollution control.

I. SITUATION AND PROBLEMS

1. THE WORLD'S FORESTS

1. General

Roughly one third of the World's land area is forest land (4,126 million ha). Of this 3,712 million ha are actually covered with forest vegetation and this constitutes the world's forest area. These figures, and those shown in Table 1, are taken from the FAO World Forest Inventory 1963 and subsequent studies.

It will be seen that the developing regions account for 55 per cent of the total forest area. The Table also shows that close to 40 per cent of the total forest area is classified as unproductive and/or protective forests, and that this category is much more heavily represented in the developing than in the developed regions.

Table 1 - World Forest Area (million ha)

<u>Developed Regions</u>	<u>Forest</u>	<u>of which unproductive and/or protective</u>
North America	710	300
Europe (excluding USSR)	148	22
USSR	738	38
Japan	24	1
Oceania (developed)	52	19
sub-total	1,672	380
<u>Developing Regions</u>		
Latin America	794	445
Africa	711	416
Asia (excluding Japan)	495	165
Oceania (developing)	40	25
sub-total	2,040	1,051
Total world	3,712	1,431

2. Ownership

Governments have a special and in some ways unique position with regard to forests and associated lands. This is not only because of the direct economic utility of the forest domain in providing valuable raw material, spread over a relatively long production cycle: also and more often because it serves important public interests such as the preservation of scenic and recreational areas, and exerts a powerful and beneficial influence on man's environment, water supplies, agriculture and livestock farming.

These features have led many countries to retain large areas of forests and associated lands in public ownership and to have special laws and agencies for the management and development of such lands. Approximately 70 per cent of the World's forests is under public ownership.

Regardless of ownership vigorous governmental leadership is nearly always necessary to ensure and finance adequate measures for forest conservation and development. In many countries governmental responsibility is acknowledged over privately owned forests where public interests are involved. Such safeguards will no doubt in time spread to all countries.

3. The Forest Types

In general terms, there is a fairly good correlation between the climatic conditions of a particular area and the types of forest vegetation occurring there. Higher altitudes at lower latitudes may produce forest types similar to those found at lower altitudes and high latitudes. The pattern is broken where special edaphic or hydrological conditions take prevalence in the determination of the vegetation type. Also the exposition - degree and direction of slope - is of much importance locally.

To the naturally occurring forest types must be added the so-called man-made forests which are of increasing importance, though their area is still modest in comparison with the total area of forest land ¹/₇. Attention should also be drawn to the tree vegetation, natural and artificial, outside the forests, of considerable relevance in many areas.

Appendix 1 gives a brief description of the major forest types of the world, while Appendix 2 contains information about the man-made forests.

4. The Forest Ecosystem

All ecosystems function through primary producers, the green plants which synthesize simple inorganic substances into complex components, and secondary producers, the many organisms which utilise the primary material or its derivatives. Part of the secondary production is a decomposition, releasing nutrients for recycling. What characterizes the forest ecosystem are particular qualities with regard to such factors as structure, dimensions, complexity, maturity, stability, capacity for self-perpetuation and self-protection, and ability to influence and protect environmental parameters. The forest usually represents the ultimate stage in a vegetational succession. The forest community has developed as a result of a long evolution of species and populations of organisms and of the long process of this adaptation to the environment as well as mutually.

This characterization of the forest ecosystem is valid, evidently, within certain limits, and to a somewhat differing degree in different ecological zones. A constant feature is the inter-relationships and interdependence between the many components of the ecosystem. The destruction or the favouring of one component may have far-reaching effects which are difficult to forecast, or in any case require an intimate knowledge of the ecosystem for their evaluation.

The complexity of forest ecosystems varies with the climatic zones in which they occur. They are less complex when low temperatures or low humidity prevail, but retain the general characteristics. A summary account of the major problems connected with forest use, management and conservation in the temperate zones, the arid and semi-arid zones, and the tropical humid zones is given in the following section.

¹/₇ of. "FAO World Symposium on Man-made Forests and their Industrial Importance,"
FAO (3 vols. and Unasylva Nos. 86-87, 1967)

5. Use, Management and Conservation

Man has been, and still is, a collector of forest products, a fisherman, a hunter, a keeper of domesticated animals, a shifting cultivator, a settled farmer, a constructor, a miner, and so on. The forests have been considered by man, at various times and conditions, as enemies, hunting grounds, protection and shelter, sources of several useful products, and sources of land for grazing and cultivation. Man's action, consciously or unconsciously, has as a rule been against the forest, rarely in its favour. Cutting, grazing and fires have over centuries caused a very marked reduction of the forest area in all continents. While such reduction is now essentially stopped in the developed countries, it continues in most developing countries, in many places at an alarming rate. Deterioration in quality and composition of the forest is common, but less conspicuous than reduction in area.

Today it is assumed that about half of the world's forests are subject to some form of control of their use or planning of their management. This ranges from very elaborate working plans to specifications in concession agreements (contractual) or in laws or regulations (legal). In some cases, control is not fully enforced and the rules remain partly theoretical. The figures in Table 2 show the situation in Europe where practically all forests are under some form of organized management, and in Africa and South America where this applies to only about 20 per cent of the forests.

Table 2

(million ha)*	Working Plans	Legal and contractual	Others
Europe	62	69	3
Africa	13	87	375
South America	10	105	445
Pacific Area	7	45	37

* Coverage for the four regions was 97, 61, 67 and 99 per cent, respectively.

(i) Temperate zones

The northern belt of the northern temperate zone is the southern, larger and more valuable part of the taiga, the cool coniferous forests. Then follow the mixed temperate forests which, together with continental steppes, constitute the major portion of the zone. Smaller areas of dry forests occur in the southern part (Mediterranean countries, Texas, Arizona).

The southern temperate zone, with a much smaller land area (southern parts of Chile, Argentina and Australia; New Zealand), has warm temperate moist forests in New Zealand, Tasmania, parts of Victoria and N.S. Wales, and the SW-most tip of Australia. There are mixed temperate forests in Southern Chile, and dry forests and steppe elsewhere in the zone.

Forestry, optimum use of the forests with planning for sustained or improved yield, was born in the northern temperate zone, in Europe, and conversion from exploitation to planned use is more recent in North America and the USSR. ^{1/}

Major problems, apart from deficiencies in policy, legislation or planning in some areas, are 1) fires, 2) diseases and insects, 3) soil and water conservation, 4) mechanization and industrialization.

Fires change the environment, often drastically, over very large areas each year. Diseases and insects take a large toll of the forests, varying in intensity from year to year and from place to place. Forests on erodible soils and sloping ground must be managed for soil and water conservation as priority consideration. Mechanization, because of the heavy investment, leads to concentration of work with consequent negative effects, e.g. insolation, grasscover, soil compaction, damage to standing trees and to young growth, etc. Industrial plants, such as pulp and paper factories, cause pollution through their effluents, smoke, etc. There is considerable damage to forests in the vicinity of industrial conglomerates.

(ii) Arid and semi-arid zones

Forest lands in the semi-arid zones are mostly open forests (*forêts claires*) or savanna woodlands; these formations occur in all parts of the world with severe dry seasons and are particularly extensive in tropical and sub-tropical regions. The overriding limiting factor is moisture, and the forest formations are frequently unstable and do not easily reconstitute themselves after destruction. Soils are erodible in many areas. Trees are usually short and badly formed, and growing stock volumes are in most cases low.

Dry forests have been extended over time by the action of man through grazing and forest destruction, typically in the Mediterranean region. In Africa there has been a century-long advance of the dry forests at the expense of the rainforests, due largely to fire, grazing, and shifting cultivation.

The dry forests are in many areas important producers of poles and fuel for the local population, and they constitute some of the world's most productive and best known wildlife habitats. They also furnish the areas for many of the world's new man-made forests, in the less arid parts.

In the less arid parts of the zone, priorities of use will have to be allocated and management adjusted accordingly. Problems are more acute in the more arid parts where the savanna woodland changes into various forms of thorny scrubland, bordering the desert. To arrest the expansion of the desert (Sahara, Rajasthan, etc.) has been a much talked about subject in recent decades, and it is becoming still more important. One of the actions to pursue is to establish a stable vegetation cover in such sites of the desert fringes that will support the growth of selected, drought-resistant trees, shrubs and other plants.

^{1/} Forest ecosystems in north-west-central Europe were generally of a certain simplicity with regard to the number of important tree species, and equitability was low, i.e. that in a given limited area most often only one or two species were dominant. Centuries of management have rather accentuated this as the trend, with some noteworthy exceptions, has been towards pure and even-aged stands.

(iii) Tropical humid zones

The tropical rainforest, with its major occurrences in the Amazon basin, central Africa, and the south-east Asian coastal and island areas, is characterized by its large number of usually evergreen species and its multi-storied structure. On the fringes, a transition to sub-humid or moist deciduous types is the rule; in places the transition leads almost direct into dry formations.

Principles of sustained yield forest management were transferred from Europe and applied in some tropical forests, particularly in parts of South-East Asia. However, most tropical forests have remained either without any planned management or with various types of schemes or plans based on inadequate knowledge of the ecological (and social) factors at play. ¹ Removal of the valuable species generally leads to quality deterioration, and this is accelerated by shifting cultivation and fires. The process may become irreversible, e.g. when soils are shallow or erodable.

The lines of attack are therefore the introduction of minimum management plans, attempts at settling the shifting cultivators, and some measure of fire control. The FAO Committee on Forest Development in the Tropics has in fact sponsored a code for the experimental management of tropical rainforests which is expected to be made available soon.

Relatively few tropical rainforests are constituted in such a way that it may be expected that they can be managed in perpetuity on the basis of natural regeneration in an economically and ecologically satisfactory manner. In most cases where the land is not ceded to agriculture or other uses, artificial regeneration is applied, ranging from sporadic enrichment planting to complete plantation establishment; in the latter case an entirely new ecosystem is developed, frequently consisting of even-aged stands of a single conifer species, with attendant risks from diseases, insects and fires.

Since continued expansion of forest plantations - man-made forests - is unavoidable, due to the increasing demand for industrial raw material, plans should now be made for the gradual reservation of very large and well distributed areas of tropical forest lands, to be managed for recreation, tourism, wildlife and products for local use.

2. THE INFLUENCE OF FORESTS ON ENVIRONMENTAL QUALITY

As has been shown, forests occupy about one-third of the world's land area, and are to be found in almost all the regions of the earth. It is evident therefore that merely in terms of physical extent forests ought to exert considerable influence on the world's environmental quality. Moreover, forests are also the most complex of the ecosystems, and interact with other factors of the environment in an almost infinite variety of permutations. In consequence, the role of the forests in conserving and enhancing environmental quality is played not only at the local level, but also on a global scale.

¹ Among the reasons for this are the very complexity of the tropical rainforest ecosystem and the biometrical difficulties of growth determinations. The unmarketability of the majority of species makes it economically prohibitive to invest sufficiently in research and experimentation.

1. Role of forests at global level

It has been pointed out^{1/} that the most important properties of the earth's surface which influence climate, and which are likely to be affected by human activity are reflectivity, heat capacity and conductivity, availability of water and dust, aerodynamic roughness, emissivity in the infra-red band, and heat released to the ground.

In all these aspects forests are important. The reflectivity of the forests is low because of the high light absorptive capacity of their green leaves when converting radiant energy to chemical energy. Indeed, it is well established that densely built up areas and deserts have a higher albedo (reflective surface characteristic) than forests, and that a unit increase in the earth's albedo will cause a decrease in average surface temperature of 1.8°F. ^{2/}

Moreover, the capacity of the forests to absorb heat is high because large amounts of latent heat are fixed during the evapo-transpiration process. By contrast, forests have a low heat conductivity because their thick and complex structure prevents rapid cooling or heating, and regulates the heat released to the ground.

There is some conflict of opinion with regard to the influence of forests on the total water supply. However, there is little doubt that forests regulate water supply by restricting run-off during the peak rainy periods, and releasing water through springs and rivers during the dry seasons. Thus, the total amount of water available for use may be significantly increased through its release from the forests in those seasons when it is most needed.

Forests, by acting as windbreaks, also create aerodynamic roughness and assist in arresting dust particles. Their emissivity of the infra-red band is also very high. It is evident, therefore, that the forests play roles which affect all the important factors which influence climate.

Forests also affect the composition of the atmosphere. Green plants are the only organisms capable of converting radiant energy from the sun into chemical energy. During this process of photosynthesis carbon dioxide is assimilated and oxygen is released. The total rate of net photosynthesis is estimated to fix nearly 80 billion tons of carbon per year. When it is realized that nearly half of this process occurs in forests, their significance as atmosphere purifying agents would be clearly appreciated.

From time to time there have been predictions that the balance between carbon dioxide consumption and oxygen production would be disturbed. However, the effect of an increase of carbon dioxide in the atmosphere is the subject of considerable controversy in the scientific community. Be that as it may, it seems certain that the biosphere would respond to an increase in atmosphere carbon dioxide by increasing photosynthesis. As carbon dioxide consumption is to a great extent linked to the forest ecosystem, the presence of forests tends to keep the concentration of carbon dioxide at acceptable levels.

Forests, therefore, are one of the climatic buffers on which mankind depends - a buffer which, because of its complex organic structure, is able to withstand somewhat severe perturbations of its physical environment, provided that the changes and stresses to which it is subjected are not pushed beyond a certain threshold. ^{3/}

- ^{1/} Wilson, C.L. (Ed.) (1970) - Man's Impact on the Global Environment. M.I.T.
- ^{2/} USA Congress (1970) The First Annual Report of the Council on Environmental Quality.
- ^{3/} Eugene P. Odum - The Strategy of Ecosystem Development. Science Vol. 164 (April 1969).

2. Role of forests at local level

The influence of forests on the human environment at the local level may perhaps best be classified as (i) physiochemical; (ii) mechanical; and (iii) psychophysiological. 1/

(i) Physiochemical influences

The physiognomy of the forests is such that it provides an extremely efficient barrier to precipitation. When rain 2/ falls its downward progress to the forest floor is impeded by the canopy of the forest, and by the various layers of vegetation within the forest.

The interception storage capacity (the maximum amount of water that can be retained by the canopy) varies from stand to stand and from species to species, and is also influenced by the frequency and intensity of rainfall. 3/ Its values, which are usually expressed in terms of equivalent rainfall over the area occupied by the stand, may range from 0.3 to 7.6 mm for conifer stands, and from 0.2 to 2.0 mm for deciduous forests. 4/

Intense rainfall releases energy with a tremendous dispersion capability. Thus, it has been calculated that 50 mm of rain per hour would have six million foot pounds of kinetic energy - sufficient to raise a 17 cm layer of soil to a height of one metre over the same area. 5/ The forest canopy by intercepting rainfall causes changes in the rate and time of water delivered to the ground, and, most important of all, dissipates the energy impact of rainfall.

Forests offer another line of defence. The accumulated litter on the forest floor acts as a cushion which absorbs the impact of the falling water, and prevents drainage to the soil beneath. This cushioning litter layer also takes account of any unintercepted rain which may fall directly onto the forest floor through the open spaces of the forest canopy.

The result of this interceptive power of those parts of the forest that are above ground is that there is little or no compaction of the forest soil. This is an important service in the protection of the soil against erosion, and in the regulation of water yield. If the soil is bare and unprotected, the impact of the rain leads to its compaction, clogs its pore spaces, and reduces its infiltration capacity. The water does not therefore penetrate into the soil but runs off, taking with it the soil particles. Apart from its impact-absorbing effect, the litter layer, because it is not a smooth surface, reduces run-off by providing obstacles to the unintercepted overland flow.

1/ FAO (1962) Forest Influences.

2/ Snow is also, of course, intercepted by the forest canopy, and interception values as high as 32 percent of fall have been quoted. Canopy intercepted snow together with that trapped within the forest itself can be a major source of stream flow.

3/ Leyton, L. and Rodda, J.C. (1970) - Precipitation and Forests. Joint FAO/USSR International Symposium on Forest Influences and Watershed Management. FAO, Rome.

4/ Zinke, P. (1967) - Forest Interception studies in the United States. International Symposium on Forest Hydrology. Pergamon Press. U.S.A.

5/ Bailey, R.W. and Copeland, O.L. (1965) - Vegetation and engineering structures in flood and erosion control. Technical Bulletin Intermountain Forest and Range Experimental Station, Ogden, Utah, U.S.A.

In addition to vertical interception, there is also what is sometimes called horizontal interception. The edge effects that are provided by forests on the horizontal movement of water may be of local hydrological significance. Perhaps the best known type of horizontal interception is that which occurs when fog clings to vertical surfaces and gives a fog drip or occult precipitation when an ordinary rain gauge in the open records nothing. For example, in the Canary Islands, during a period of a year, condensation of mist in a Eucalyptus forest trebled the rainfall, whilst on the south-eastern banks of Hokkaido in Japan, the equivalent of 3 mm of rainfall were obtained in 27 hours from fog drip in deciduous stands. In Panama "cloud forest associations cover sites where the presence or absence of forest cover definitely makes significant difference in total runoff and rainfall. The taller the vegetation cover, the greater the condensation of water on foliage and branches. Without some regulatory mechanisms the trees would grow so tall, condense and drip to the ground so much water that the soil would become too swampy for good growth of the large trees which would fall down due to unstable soil conditions combined with shallow rooting, epiphytic vegetation becomes sufficiently abundant to utilize through transpiration and to catch the drip from above which prevents tree growth in height. Since cloud-cover and condensation on high ridges are frequent phenomena during the dry season, the water from condensation is extremely important for power development and irrigation projects." ^{1/}

Forests do not only reduce the impact of the rain on the soil; they actively assist infiltration, i.e. the movement or flow of water downwards through the soil surface. This is very useful, for if run-off is reduced or retarded, the only alternative to infiltration is undesirable permanent water-logging.

The organic matter which falls to the floor of a forest (leaves, twigs, flowers, fruits, branches, etc.) is first oxydised and hydrolised. Later, fungi decompose the solid matter still further and insects transport this pulverised material downwards into deeper layers. The combined effect of this chemical and biological action is the conversion of the litter into humus. The presence of humus in the soil at the immediate soil surface improves its texture, increases its permeability, and therefore aids infiltration.

But this is not the only result of the presence of organic matter on the forest floor. The plant residues, in addition to providing food, also furnish favourable living conditions for various micro-organisms. Some of these micro-organisms ramify the upper layers of the soil, and thus, in addition to transporting organic matter, they create a capillary system which permits the easier infiltration of water. As the roots of trees decompose, they also leave channels which serve as downward passage ways for the water held on the soil surface by the litter layer.

It is apparent, therefore, that the forests decrease surface run-off, increase the infiltration capacity of the soil, and assist the percolation of water downward through the soil. This is an extremely important service to the community, for if most or all of the rain which falls is permitted to run-off the surface of the land, the consequences may be very far-reaching. First, the existing drainage system may be unable to accommodate all the water released during the rainy season and this may lead to severe flooding, and the occurrence of torrents. Secondly, as water moves more rapidly over the surface of the land than through the soil, its ability to remove soil material is increased when there is no vegetation cover, and erosion is accelerated. The soil materials that are removed by the water are eventually deposited, and may cause great damage by filling and silting reservoirs, raising river and stream beds, and covering farmlands. Thirdly, by reducing the over-land flow during the rainy season and releasing it more slowly, to the springs which feed the streams, in the dry season when it is most needed, the forests help to regulate the supply of water and reduce the possibility of droughts. Fourthly,

^{1/} Eren, T. (1970) Watershed Rehabilitation - Chiriqui Viajo and Caldera Rivers, Panama. Consultant Report, FAO.

in addition to its cushioning effect, and the part which it plays in increasing infiltration, the litter layer on the forest floor acts as a filter which purifies the water which eventually reaches the streams. Also, by reducing the overland flow with its high concentration of sediment, the forests in yet another way contribute to the relative purity of the water. Indeed, the influence of forests on various elements of water quality such as temperature, colour, taste, microbial population, suspended sediments, and dissolved solids are very frequently positive under undisturbed forest conditions.

The importance of the physicochemical role of forests may be illustrated by the following examples. It has been found that under certain conditions, only two percent of a 50 mm per hour rainfall ran off the surface of the land when there was 70 percent forest cover. However, in similar conditions but with forest cover reduced to 37 percent and 10 percent, the surface run-off increased to 14 and 73 percent respectively. Moreover, the amount of soil eroded varied with the degree of forest cover. Thus only 0.05 tons per acre eroded from the area with 70 percent forest cover while 0.5 tons per acre and 5.55 tons per acre were respectively eroded from the areas with 37 percent and 10 percent forest cover. 1/

Over a period of twenty-one years the sediment yields from areas under forests have been compared with those from other types of land-use. It has been found in the areas investigated that under forest conditions sediment yield was about 50 tons per acre per year, from urban and suburban land 50 to 100 tons, from farmland 1,000 to 5,000 tons, and from land stripped for construction 25,000 to 50,000 tons with an average annual run-off of 15 inches, the maximum turbidities in parts per million were 45; 90; 4,500 and 45,000 respectively in the various areas described above. 2/

This type of result has been used by foresters in providing communities with required amounts of water, in regulating its quality, and in controlling the period of its release. For example, if the major aim of watershed management is to increase water yield, then the density of the forests should be reduced to a safety limit which while decreasing interception and evapo-transpiration would ensure that sufficient cover is provided to minimize erosion.

(11) Mechanical influence

Winds can exert a quite deleterious effect on plant and animal growth and productivity. This is caused by their dessicating effect, by their impact on temperature, humidity, and snow cover, by their abrasive action, and by the soil erosion which often occurs when wind velocities are high.

One way of overcoming the necessarily attendant problems is to modify the micro-climatic conditions by erecting windbreaks or shelter belts of forest trees. As a consequence of the more favourable environment created by these trees, crop and animal yields are often increased. Moreover, as shelterbelts are usually established in treeless regions, they also improve the amenity value of the areas in which they have been laid down, and provide recreation and facilities that might otherwise not be available.

1/ Bailey, R.W. and Copeland, D.C. (1965) - Vegetation and Engineering Structure in Flood and Erosion Control. Technical Bulletin Intermountain Forest and Range Experimental Station, Ogden, Utah, U.S.A.

2/ Lull, H.W. (1969) - Hydrologic Effects from Urbanization of Forested Watersheds in the Northeast. Northeast Forest and Range Experimental Station, Penn. U.S.A.

Shelterbelts and windbreaks reduce wind velocities. When wind strikes the shelterbelt, part of the air current passes through the belt and then divides into minor turbulences; another part rolls over the belt; the remainder rises above it. The effect of a shelterbelt on wind velocity depends on the height and permeability of the belt, the lay-out of the belt in relation to the prevailing wind, and on whether the shelterbelts are laid down as a system.

Although the extent of the protected zone is proportional to the height of the windbreaks, and is determined almost entirely by this factor, the density or permeability of the shelterbelt is of considerable importance in reducing wind velocity. Dense shelterbelts, although providing a greater degree of shelter immediately leeward, do not give the same degree of protection even at shorter distances away from the barrier. On the other hand, permeable barriers provide adequate protection at far greater distances.

It appears that the optimum permeability is between 30 and 55 percent, and the effect of permeable belts on wind velocity increases considerably with growing speed. For example, if wind velocity goes up from 3.3 to 7.5 m/sec, the capacity of a five-row belt to reduce wind speed increases by 11 percent. ^{1/}

The direction of the prevailing wind is also important. The greatest reduction of wind velocity is obtained when the shelterbelt is at right angles to the prevailing wind. As the angle of incidence to the wind increases, the belt's effectiveness decreases.

Shelterbelts and windbreaks are more capable of reducing wind velocity when they are laid out as a system than if they consist of unrelated individual belts. A system of shelterbelts may have an accumulative reducing effect on wind speeds; in addition, extensive systems of shelterbelts and windbreaks increase the roughness of the ground surface, thus providing more resistance than bare areas.

The services which shelterbelts provide are quite remarkable. Their influence on air temperatures varies at different times of the day and with different seasons as well as with the structure of the belt. The reduction of the vertical diffusion and mixing of the air usually results in an increase of temperature by day and a decrease by night. If evaporation is decreased by wind reduction, the air becomes warmer; on the other hand, if soil moisture is improved, through snow drift for example, evaporation may increase and temperatures fall. Soil temperatures are higher in protected areas than in the open.

Both the absolute and relative humidity of the climate near the ground are usually higher than in the open, as is the absolute air humidity. The moisture content of the air in sheltered regions is therefore significantly greater than in areas of unobstructed wind and total evapo-transpiration is reduced. Studies carried in Uzbekistan by the Central Asian Research Institute have established that on sheltered irrigated land, humidity was 10 to 15 percent higher in the month of July than on open land. In dry farming areas, relative humidity was found to be 5 to 12 percent higher on the leeward side of a semi-permeable shelterbelt, and 6 to 18 percent higher on the same side of a permeable shelterbelt than in open areas.

Most studies have indicated that evaporation is considerably decreased on the leeward sides of shelterbelts, because of reduced wind movement and air temperature, and increased atmospheric humidity. Moreover, soil moisture is higher in protected areas than in open fields. In the USSR, the moisture content of the top metre of soil has been found to be 25 to 30 percent higher in the middle of protected fields.

^{1/} FAO (1969) - Report on the FAO Study Tour on Shelterbelts and Windbreaks in the USSR. June-July, 1967. FAO, Rome.

However, because of root competition, soil moisture is generally low in those sheltered areas immediately adjacent to the windbreak.

On the basis of extensive research carried out in many parts of the world, the influence of shelterbelts and windbreaks on soil properties may be summarized as follows. Shelterbelts

- (a) protect the soil (especially fine-textured and sandy soils) against wind-blow;
- (b) create water stable aggregates and improve the soil's porosity, infiltration capacity and resistance to erosion;
- (c) increase the soil's water-holding capacity;
- (d) result in a higher humus content, more nitrogen and phosphorous, deeper carbon accumulation, fewer sulphates, and less water soluble salts;
- (e) increase the depth of the A horizon; and
- (f) activate micro-organisms thus increasing the effectiveness of mineral fertilizers.

Because of their ameliorating effects on the micro-climate and on the soil, and because of the physical protection which they provide, shelterbelts increase the quality and quantity of the crops which they shelter.

The positive effects of shelterbelts are, of course, most noticeable in areas where growing conditions tend to be critical. Thus, in an area in which precipitation was the limiting factor, yields of summer and winter wheat, rye, oats, and alfalfa were between 150 and 300 percent higher in areas protected by shelterbelts than in unprotected fields. Moreover, the rate of germination, flowering, and boll formation and production of cotton was considerably increased by the provision of shelterbelts. In addition, cotton plants grew higher, produced heavier cotton bolls, and gave higher cotton yields. Where shelterbelts have been used to protect fruit and vegetables, physical damage has been reduced, yields have been increased, and ripening has been earlier. Shelterbelts and windbreaks also offer protection to livestock from excessive winds and heat. The belts have been shown to improve the respiration of cattle, to reduce their body temperature, to decrease calf mortality, and to improve beef and milk yields. Flocks of ewes raised under shelterbelts have been observed to produce 20 percent more wool per head, to be 30 percent heavier at the time of slaughter, and produce 30 percent more lambs. ^{1/}

(iii) Psychophysiological influences

Because of the diverse nature of the physiogeography and floristic composition of forests, because of the variety of fauna which they shelter and for which they provide food, because of the streams, rivers and lakes that are generally to be found in them, and because some regard them as things of beauty, forests have come to provide what may be described by the generic term of recreational services.

From time immemorial, the nobility had used the forests for relaxation and sport. Indeed, the earliest forest laws were primarily concerned with hunting and fishing, and although the Forest Code which Charles V of France promulgated in the XIVth century was designed to provide timber for a navy, the recreational aspects of forestry were not neglected. Manwood's treatise on the forest laws of England, which he published in 1717, was also chiefly on hunting and the protection of animals for sport.

^{1/} FAO (1969) - Report on the FAO Study Tour on Shelterbelts and Windbreaks in the USSR, June to July 1967. FAO, Rome.

During the last two decades or so, the use of forests for recreation has grown considerably, particularly in the developed countries. There are several reasons for this increase in recreational demand. First, there is a general reduction in the number of working hours of the average person and a consequent increase in leisure time. Second, standards of living are rising. Third, societies all over the world are tending to become more urban, and for some psychological reason, people tend to seek relaxation in areas that are dissimilar. Fourth, with the growth of industrialization, there appears to be a need to escape from the often soul destroying effects of an industrial society.

Many people go to the forests for recreation, not merely because of their aesthetic attractiveness, but perhaps because of the instinctive belief that they would "do them good". This instinctive reaction is supported by the available evidence. Forests, because of their structure and functioning, increase the salubrity of the air by fixing dust and other impurities on the surface of leaves, and by the assimilation of ozone. Forests also create changes in the turbulent pattern of the wind, thus reducing the air's propensity to pick up impurities.

Forests may also make a valuable contribution to the physical and mental stress which often results from over-crowding in urban environments. In this respect, the observed facility of forests to absorb noise may be of considerable importance. Preliminary studies indicate that appropriate barriers of trees and shrubs can reduce the sound level by as much as 10 decibels. This is approximately a 50 percent reduction in apparent loudness.

People also go to the forests to observe wild life in their natural habitat. Forest areas have always been a vital habitat for wildlife as they provide the essential features of life: cover, food, and water. The diversity of forests permit a corresponding diversity of wildlife. Indeed, without forests many species of animals, such as Brown Bear in Europe, gorillas in Africa, and Cebid monkeys in South America, could not survive.

Careful attention must be paid to the wildlife aspect in developing forest resources. In many areas, multipurpose use is the best approach to rational management.

3. ECONOMIC DEVELOPMENT AND THE FOREST ENVIRONMENT

The contribution which the forests make to the human environment has been emphasized in the previous pages. However, the forests are not inviolate, and in many parts of the world they are being razed to the ground. They are being felled to yield new areas to produce food for rapidly increasing populations, to provide the wood raw material for forest industries, to earn foreign exchange in the booming world trade for forest products, and to absorb labour from the growing ranks of the unemployed. The possible impact of forestry and forest industries development is reviewed in the following sections:

1. Forestry development

It is not the intention of this paper to advocate that the world's forests be preserved and left untouched. On the contrary, it may be demonstrated that the concept of the natural, untouchable forest is dangerous. ^{1/} If forests are to

^{1/} For example, it has been demonstrated recently that net oxygen release is greater in growing than in more mature forests. It follows, therefore, that mature forests should be managed so that they may be replaced by younger and more vigorous trees.

contribute to the growth of national economies, and, at the same time, preserve and enhance the quality of the human environment, they should be managed scientifically. Scientific management implies interference - but a rational, informed and knowledgeable interference; not the uncontrolled exploitation of large areas of the forest ecosystem.

In Latin America, between five and ten million hectares of forests are felled annually for agriculture. In the Far East as a whole, it is thought that there are about 24.5 million shifting cultivators who annually fell forests up to approximately 8.5 million hectares, and that the total area under shifting cultivation is at least 103 million hectares. 2/ 2/ The opinion has been expressed that in Africa, south of the Sahara, the area of closed tropical high forest has shrunk by at least 100 million hectares from its original extent because of this system. 3/ For example, in the Ivory Coast, forest inventories were made in 1956 and 1966. In the intervening period, 2,800,000 hectares, or 30 per cent of the area covered by forests in 1956, were cleared by itinerant cultivators. 4/

FAO has estimated that in Burma timber of the value of \$31.5 million is destroyed by shifting cultivation each year. In Guinea the figure is \$40 million; and in Colombia it rises to the astronomical height of \$80 million. 5/

The main reason for the rapid spread of shifting cultivation is, of course, the high rates of population growth which are occurring in tropical areas. However, as has been pointed out, 6/ the land under shifting cultivation is capable of supporting only a population of less than twenty persons per square mile, and in general the system is fairly stable at that level. Where, however, the population increases, the fallow period is necessarily shortened, soil deterioration occurs, and productivity is reduced.

Therefore, there is very little that is intrinsically wrong with the system of shifting cultivation under conditions of low population densities, and relatively extensive land areas. There are even some examples which show that conservation and production can be reconciled. 7/ As practised today, however, it not only reduces the economic potential of the nation's forest economy, but it also adversely affects the world's environment.

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- 1/ FAO (1961). Timber Trends and Prospects in the Asia-Pacific Region, FAO, Rome.
 - 2/ In the Philippines, the annual destruction of forests by shifting cultivation is about 350,000 hectares. On the island of Mindanao alone, over one million hectares were cleared of forests over a period of 11 years. Mercado, J.L. (1971). Manila's National Suicide Formula, Depthnews.
 - 3/ FAO (1966). Wood - World Trends and Prospects. Unasylva, Vol.20 (1-2)
 - 4/ Lanly, J.P. (1969) - Régression de la Forêt dense en Côte d'Ivoire. Revue Bois et Forêts des Tropiques, No. 127
 - 5/ FAO (1969) - Shifting cultivation in tropical forests. FAO Committee on Forest Development in the Tropics, 2nd Session. FAO, Rome.
 - 6/ Nye, P.H. and Greenland, D.J. (1960) - The soil under shifting cultivation. Tech. Com. No. 51, Com. Bur. of Soils - Com. Agric. Bur.
 - 7/ FAO (1957) - Manure Agriculture in the Philippines.

In some cases forest exploitation also contributes to the reduction of the services which forests provide. Because of the special characteristics of wood as a raw material, the high linkage effects which are engendered in the various types of wood processes, and the importance of wood and wood products in international trade, forests and forest industries have come to be regarded as being of special importance in the attack on economic under-development. 1/ Not surprisingly, therefore, Governments have in many cases granted concessions to exploit their forests.

Unfortunately, in many cases the chief concern seems to be rapid exploitation. As has been shown, among the reasons for the facility of forests to regulate and purify water supplies and to reduce erosion are the presence of a litter layer which reduced surface soil compaction, and the high humic content of the surface soil which increases its infiltration and filtering capacities. Unfortunately, the efficient transportation of forest products often entails the building of roads and the use of quite heavy equipment. This almost inevitably leads to the disturbance of those conditions which make forests such a remarkable reservoir and purifier. As has been said, the "beneficent effects derived from long-time protection can disappear rapidly under the tractor..... or trampling of a short-term harvesting operation". 2/

As far as the deleterious effects of logging on forest soils is concerned, it has been pointed out, for example, that, although crawler tractors, compared with wheeled vehicles or horses, exert the least compaction 3/, their over-all effect may be more adverse because of the greater area of soil subject to mechanical vibration. 4/

Moreover, as the very existence of forest cover minimises erosion, it follows that in areas susceptible to erosion, where there is intensive logging with its clearances, extraction roads, storage depots (and with the attendant compaction of the soil through the use of heavy machinery for timber haulages) there is the danger of increased erosion.

Similar problems may arise when production forestry is practised in forests which are in demand for recreation. In general, recreationists do not like to see unsightly clearings, accumulated forest waste, tree stumps, and all the mechanical paraphernalia of extraction. Forest production may therefore, unless carefully conceived and executed, have a limiting effect on the use of forests as centres of recreation.

On the other hand, visitors to the forests can seriously hinder forestry activities. They can trample on the soil and compact it, tread on and uproot seedling regeneration, light fires and burn forests to the ground, and cause damage to the growing trees, making them susceptible to subsequent insect and fungal attack.

There is no intention to labour these points. Foresters have over the years evolved systems of management and methods of exploitation which safeguard the forests against damage, provide the wood raw material for the development of industries, and at the same time ensure that the effects of exploitation on the human environment are positive rather than negative. Sound forest management may aim at conserving the forest resources; it is never its objective to preserve it. These aspects of forest management are discussed in Chapter II.

1/ Westoby, J.C. (1962) - Forest industries in the attack on economic under-development. Unasylva, Vol. 16 (4)

2/ Lull, H.W. (1959) - Soil compaction on forest and range lands. USDA Misc. Pub. No. 768

3/ Anan (1954) - Comparative Specifications of Crawler Tractors. International Harvester Co. Industrial Power Sales Eng. Dept. 111.

4/ Huberty, M.R. (1944) - Compaction in Cultivated Soils. Trans. Amer. Geog. Union 25

2. Forest Industries Development

Forest industries, particularly the pulp and paper industry, are considered to be substantial polluters of air and water. It is quite true that if these industries are operated strictly from the point of view of obtaining maximum financial returns there would be very substantial pollution. Indeed there have been many cases in the past when this situation has prevailed.

As time has gone by, however, the necessity to pay increasing attention to the impact of industrial production on the environment has forced these industries to reduce or eliminate pollution. It should be emphasized that the control or elimination of pollution is not a technical problem; it is purely an economic question. The expenditure involved to control pollution is substantial but is not so high that the industry cannot afford to do it. It is possible, however, that as stricter pollution limits are established the producer's financial burden may eventually become so great that he is forced to increase the selling price of products. Even so, the necessary increase in capital and manufacturing costs in a typical big pulp and paper mill would not be more than 10 percent.

Pollution is also created by the mechanical woodworking industries such as sawmilling, plywood, particle-board and fibreboard manufacture. Wood waste, such as sawdust, offcuts, etc., is or used to be disposed of by burning, when it has no other use or value. It is obvious that such incineration creates such pollution as smoke and ashes.

The pollution control problems faced by the pulp and paper industry are, of course, much more complicated than those associated with the mechanical woodworking industries. Many pulping processes result in the production of unpleasant gases and odours, some of which are toxic when they are in concentrated form. Pulping processes remove from the wood up to half of its weight by dissolving the compounds which bind the fibres together. While it is normally an economic necessity to recover the dissolved wood compounds and the chemicals used to process the wood, it is difficult to justify economically a 100 percent recovery. Pulping of wood also normally produces very small fractions of fibre of low value, the recovery of which is very expensive. It should be noted, however, that pollution created by the pulp and paper industry does not have the same effect on the population as pollution from other industries, because the pulp and paper mills are normally located away from urban areas.

II. POLICY GUIDELINES AND RECOMMENDATIONS TO GOVERNMENTS

It has been pointed out in the preceding pages that forests exist in almost all the countries of the world; that they are the most complex achievement of ecological evolution; that the forest ecosystem is not only living, dynamic and self-regulating, but interacts with other factors of the environment in an almost infinite variety of ways; and that this ecosystem profoundly influences the world's environment at both global and local levels. It has also been stressed that in many parts of the world, the forests are being devastated and mismanaged, and that some of the processing industries which utilize the products of the forests may pollute the environment and adversely affect the quality of human life.

It must therefore be emphasized that those goods and services which forests and forest lands provide may be obtained without deterioration of the human environment. In addition, the wood raw material may be processed without the release of pollutants to the atmosphere, and to the rivers, lakes, and seas.

Systems of forest management have been evolved which are designed not only to yield the wood products demanded by the world's inhabitants, but also to provide protection to the earth's surface, maintain the forests as places of recreation, and enable the forests to perform their air-conditioning role. Modifications may also be made to industrial processes, so that pollution may be eliminated.

1. LAND CAPABILITY CLASSIFICATION AND LAND-USE PLANNING

Despite the importance of forests, it must be acknowledged that land is in demand from all sectors of the community, and that frequently economic development can proceed only by felling forests. Unfortunately, many forest clearing schemes are undertaken without a full understanding of the interdependence of vegetation, soil, and climate, and without a true appreciation of the, possibly, far-reaching effects of replacing one type of land-use with another. It is therefore essential that land capacity classifications be formulated and land-use plans drawn up, at least in areas where drastic changes in the land-use pattern are contemplated.

Land classification is the systematic arrangement into classes of different types of land according to their inherent capability to produce crops with or without additional inputs. The placing of an area of land into any particular group will depend on a combination of the factors which influence productivity, viz. climate, topographic relief, and soil characteristics. The object of land classification is to distinguish what exists, and forecast what would occur under various uses, conditions, and circumstances. Land classifications enable the planner to appreciate the differences in quality of the land at his disposal, to estimate the inputs needed to produce this or that crop, and the costs and benefits to the nation of particular types of land-use are adopted. 1/

As Kneipp 2/ has said, "the chief characteristic of civilized man is his ability to anticipate and plan for the future". No element of man's cosmos more vitally affects his future than the land resources of the world.

There are many ways of classifying land, but certain basic factors must be taken into account: the inherent fertility of the soil, the climatic conditions (including temperature extremes, and the distribution and intensity of rainfall), angle of slope, length of slope, the infiltration capacity of the soil, and if possible known sediment yields. An assessment of these factors will enable the classifier to predict, with a reasonable degree of certainty, the effects of certain crops and cropping patterns not only on crop yields, but also on erosion and water supply regulation. Land classification is a long, painstaking process which necessitates the accumulation of vast amounts of data. For this reason, it is often avoided, and mistakes are discovered only through the harsh laws of empiricism.

Above all, it must be emphasized that it should not be assumed that the luxuriant appearance of forest vegetation necessarily indicates that the soils beneath the forest are capable of sustaining continuous agricultural cropping. As has been shown, the forest is a self-sustaining unit which is able to create favourable conditions for itself in environments which would be extremely severe for other types of crops. Only careful investigation, therefore, would reveal the inherent capabilities of land under forests.

1/ King, K.F.S. (1969) - Land capacity classification and Land-use Planning with special reference to tropical regions. Proc. of 6th World Forest Cong., Madrid, June 1966

2/ Kneipp, L.J. (1936) - Land Utilization and Planning. J. of Forestry. Vol. 34

In any case, it has been noted that in both developed and developing regions, disorders appear in lands which are marginal, either ecologically or as a result of their past use. This is the consequence of new technologies, population pressures or exodus and increasing needs. In developing countries, this is marked by the advance of desert and increasing erosion of mountain areas. It is expected that the process of stabilisation and development of marginal lands, which is already in operation in some countries, will be supported and developed by the governments concerned.

2. THE MANAGEMENT OF FORESTS 1/

If, as is possible, the exercise in land classification and land-use planning reveals that it would be in the social and economic interests of the nation that certain areas should be under forests, these forests will have to be managed.

Over the years, various systems of managing forests have evolved. These systems embody three ideas: (a) the method of regenerating the forest crop, (b) the form of the crop produced, and (c) the orderly arrangement of the forest with special reference to silvicultural and protective considerations, and to the economic utilization of the produce. 2/

Most classical systems aim at an ideal, i.e. the creation of what is termed a normal forest. A normal forest contains a complete succession of age classes from the youngest to the oldest; these age classes are represented in correct proportion, density and distribution, so that as each reaches maturity, it may be felled in its turn and regenerated. The same volume or area can therefore be felled each year or period of years, in perpetuity. The volume felled is usually equal to the annual growth of the forest. 3/

The classical silvicultural systems of forest management range from clear-cutting systems in which successive areas are clear-felled and regenerated, most often by artificial but sometimes by natural means, to the selection system in which felling and regeneration are not confined to certain parts of the area but are distributed all over it, the fellings consisting of the removal of single trees or small groups of trees scattered throughout the forest.

Between these two extremes, there are several types of system. In all of them, however, the forester carefully considers the vegetation, the other factors of the environment, and the desired end-product. Then, through his knowledge of the relevant ecological relationships, he applies the management tool most suited to obtaining the necessary forest products, and at the same time conserving the forests and the soil beneath.

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- 1/ Although emphasis has been placed in this paper on the biological aspects of management, there has within recent years been a series of important developments in management science which are gradually being employed in forestry with impressive results. These developments include systems analysis, mathematical modelling, mathematical programming (linear, non-linear and dynamic) and simulation.
 - 2/ Troup, R.S. (1955) - Silvicultural Systems. Oxford. Troup defines a silvicultural system as the process by which the crops constituting a forest are tended, removed, and replaced by new crops, resulting in the production of woods of a distinctive form.
 - 3/ Of late, valid and compelling economic arguments have been advanced against the principle of removing only the annual forest growth. However, these arguments generally apply to forests exploited only for production, and do not usually refer to protective forests, for example.

Very frequently, the species that are demanded by the wood conversion processes are not those which are found in the climax forests, but those that occur in one of the stages of the succession. An important aspect of the foresters' act is, therefore, sometimes to arrest the succession of a stage in which the forests would produce those goods that are needed by society, or to deflect the succession to such a stage, or to change part of or the entire composition of the forest. The forest may also establish plantations in areas not formerly occupied by forests, or reforest areas which have been cleared. In each case, the forester should apply his ecological knowledge in order to ensure that there are no adverse effects on the environment. In each case, he should foresee the consequences of his acts, and the chain reactions which would inevitably occur through his changes of the natural environment.

When man manages a forest, and particularly when he creates new forests, he introduces changes from natural conditions. However, there is very little substance in the argument that natural unmanaged forests are the ideal, and that drastic departures from natural forest conditions would lead to site and other environmental deterioration. Pecci has stressed the danger of adopting the concept of the natural forest as a basis for silviculture, and has shown that both the physical growth of the forest vegetation and the protective effects of the forest may be increased through sound and vigorous scientific forest management. In short, what is required is not the preservation of forests as they occur in nature but the application of sound ecological principles so that forests may be reshaped and reconstituted to meet man's economic demands, without reducing their global and local influence on the environment.

Thus, during the last five decades or so, it has been recognized in many countries that artificial, man-made forests must in many cases be established to complement natural forests, and/or to replace them. The advantages of forest plantations are many and far-reaching. They utilize time and space more efficiently and yield raw material of comparatively uniform size and quality. They provide products that can be more or less custom-made to meet certain technological requirements; they are relatively simple to manage and, unlike natural forests, their location can be planned; and they are more responsible to the advances of science (e.g. fertilizer application and tree breeding) than are natural forests.

In order to make certain that the species to be established in forest plantations will survive in the new environment, will create conditions suitable for their continued existence, and will enhance and not degrade the localities in which they are established, a series of careful scientific investigations is carried out. Several species are tried on a small scale and the failures progressively eliminated until finally those most suited to the site are selected. Only after these have been given further trials in larger plots are full-scale plantations embarked upon. Because of the long time-span between planting and maturity, some mistakes have inevitably been made. However, when the careful techniques of selection and evaluation which have been evolved are followed, the risk of mistakes is considerably reduced.

As far as logging and road building are concerned, it should be pointed out that they could have a pronounced positive effect. Logging may be carried out in order to keep the forest open and more attractive for recreation. Road building makes the forests much more accessible and thereby increases the service function of the forest. They also give better opportunity for management and fire control.

So far the discussion on forest management has been almost exclusively confined to production forestry. If a proper land classification has been made, and the correct silvicultural system followed, the dangers of erosion, soil compaction,

siltation and flooding will be considerably reduced even when exploiting the forests and extracting the produce from them. Moreover, by carefully siting extraction routes, providing side and overhead shade for forest roads, and restricting peak extraction periods to the drier seasons, mechanical compaction by heavy machinery can be minimized.

As has been discussed, the use of forests for recreational purposes is rapidly increasing. Indeed, it has been suggested that in many developed countries such as Great Britain, the forester of the future must become a resort rather than a resource manager. ^{1/} Although this is possibly an over-statement, there is little doubt that, certainly in the developed countries, and probably in the long run in the developing countries, certain forest areas will have to be set aside purely for recreational purposes.

It will probably be necessary in the developed countries to zone forests. The larger forest areas more remote from population centres could be managed primarily for wood production. With some compromises (such as leaving undisturbed the visible edges of the forests, regulating felling and extraction, and landscaping production plantations), they could also provide landscape and recreational benefits. However, at the other extreme, forests very close to population centres may increasingly have to be managed.

Nevertheless, it should not be assumed that forests must be managed to meet single objectives only. The flexibility of forests, their dynamic nature, and the compatibility of some management objectives suggest that multiple-use management and the associated modifications of silvicultural practice are feasible in certain situations.

Multiple-use forest management may be defined as the conscious and deliberate use of forest land for the concurrent production of more than one good or service. In recent years, forest planners and managers have been paying much attention to multiple-use management because of the almost universal threat to forest areas, and because of the increasing demand for those recreational and protective services which the forests provide.

The concept of multiple use is attractive because it permits the realization of a multiplicity of goals. It should be emphasized, however, that it is often impossible to maximize the attainment of more than one objective from a forest unit. Management for a mixed set of objectives often results in the failure to attain perfection in any. This is not intended as a criticism. Often, in multiple-use management, although the benefits which might have accrued from single purpose management might be reduced, the benefits which the economy gains from the combined production is greater or at least equal to those obtainable under single-use management.

It is important also to decide on the dominant use in the combination. In order to do this properly, the forest manager must be aware of the possible combination, he must appreciate the interactions of the various types of use, and he must assess the demands of society for the goods and services that are to be produced. These analyses would place him in a position to decide whether single use or multiple use should be the policy for particular cases, and if the latter, to decide on the hierarchy of the various components of the multiple use mix.

^{1/} Richardson S.D. (1970). The end of forestry in Great Britain. Advancement of Science, 27.

The stages in the decision-making process are as follows:

- (i) assess the needs of the population for the product and services;
- (ii) assess the ability of the available area or areas to supply those needs on a single-use basis;
- (iii) if the available areas can meet the demand on a single-use basis, then practise single-use management;
- (iv) if they cannot, multiple-use management is necessary and a decision must be made concerning the dominant use.

An effective multiple-use programme must, of course, be planned. Where the costs incurred in the production of the various goods and/or services can be ascertained, and where the revenue which may accrue from these goods and/or services can be assessed, then, by using the technique of indifference curve analysis, the optimum combinations may be determined. ^{1/}

Unfortunately, it is often difficult to assess the costs and benefits of the important services which the forests render, or at any rate it is difficult to convince the policy-makers of the validity of the benefits when they are expressed in quantitative terms.

It is relatively easy to estimate the costs of providing forest services to the community. For artificial forests, the costs are readily calculable; for natural forests, the opportunity costs involved by not exploiting the forests, or by reducing production, or by using special silvicultural systems can be ascertained.

The assessment of benefits is more difficult. However, if for example, it can be shown that by removing forests other areas would become subject to alternate periods of droughts and floods, the benefits might be calculated. Where recognizable and identifiable damage has occurred because of forest clearance, the cost of restoration may be used as indicative of the benefits of forest cover. But the post hoc character of this type of exercise reduces its methodological importance. In any event, the problem with regard to calculating the protective functions of forests lies not so much in the choice of methodology, but in obtaining the data to make the calculations.

The quantifying of recreational benefits is in some respects more difficult. It is not easy to ascribe monetary values to the psychological benefits of noise abatement, or to the mental distress which forests relieve when they are used for recreation. Again, a post hoc exercise may be applicable, but it would be difficult to prove that a person would not have become ill, or his productivity at work would be improved, if forests were prescribed from time to time.

If charges were levied for entry into forest areas, then, of course, the problem would be simplified. Even so, the benefits in real terms would probably be greater than the price paid for entry. Questionnaires have been suggested as a means of estimating the value citizens place on forest recreational areas. These have some merit and may perhaps be more widely employed in those countries in which Government Forest Services are forced to modify production forestry practices in order to provide recreational facilities.

^{1/} See Gregory, E.R. (1955) - An economic framework to multiple use. For.Sc. Vol. (1) No. 11

Finally, Governments often require their Forest Services to show positive balance sheets. This is a perfectly reasonable requirement when production forestry is practised, for production forestry is a business. However, these Governments almost always insist, where the demand for recreational services is high and vociferous or where protective services are obviously needed, that the forests provide these multiple services. In attempting to meet these objectives, Government Forest Services restrict their felling areas, and adopt silvicultural practices that are compatible with recreation and protection. Not surprisingly, revenue drops and the Forest Services are blamed. It is therefore important that a logical method of financing and accounting be evolved for this type of forestry.

Recommendations to Governments on Forestry

(a) Governments should formulate or revise existing national forest policies and plans so as to take into account the rapidly increasing demands for the social services which forests provide. Any institutional changes which are necessary to implement these policies should be made. In particular, adequate legislation should be enacted, an efficient law enforcement cadre provided, and the forest administrative machinery re-organized and strengthened. Accounting procedures should be revised so that the costs and benefits of social forestry are reflected in Government forestry budgets. Special attention should be paid to education and training professional foresters and technicians in all relevant aspects of environmental control; where necessary refresher courses should be provided. Attempts should be made to develop in the public a consciousness of the influence of forests on the human environment.

(b) Governments are also advised to establish planning authorities at national and/or provincial, state or local level. The main functions of these authorities would be to assess environmental values and to evaluate specific development projects by making impact surveys in advance of project implementation. These surveys would identify all the environmental components which may possibly be affected by the project, determine the effect of proposed development on each component; and recommend the appropriate measures to guarantee that environmental changes wrought by the project are held with reasonable limits.

(c) It is also recommended that urban planning commissions seek the advice of environmental foresters in establishing tree gardens and plantations to improve the appearance of the urban landscape and reduce noise pollution.

(d) Governments are also advised to establish or strengthen research organizations which would investigate the function and productivity of both natural and man-made forest ecosystems. Individual research organizations should collaborate closely with each other, and with International Agencies such as UNESCO and FAO.

3. CONTROLLING POLLUTION IN FOREST INDUSTRIES

As mentioned in an earlier part of this paper, there are no technical problems in reducing or eliminating pollution created by the forest industries. While as a rule pollution control is an economic problem, there are cases where even economics call for elimination of pollution. For example, sawdust and wood waste are often used as fuel for the production of steam and power and when they are thus burnt under proper control in a boiler they become valuable fuel and the pollution created by the burning can be substantially reduced. The increase in cost of wood has resulted in the increased use of wood waste and sawdust, and even bark, for other products such as pulp and panels. Indeed, there are hardly any mechanical woodworking

operations of industrial size in the developed world where the wood waste is not completely used by other forest industries. This does not necessarily apply to the decreasing number of very small sawmills, which may still have a problem of utilizing if not solid wood waste at least sawdust. However, it should be remembered that many of these operations are in rural areas where sawdust is still a most valuable insulation material for housing and other purposes.

As mentioned earlier, the problem of water pollution has been with the pulp and paper industries for as long as they have existed. In the beginning solutions were evolved because of economic factors, for example the chemicals and organic matter in the waste liquid from the pulp mill were found to be valuable for re-use and burning. The last two decades have seen a tremendous increase in the expenditure and efforts by the pulp and paper industry in reducing or eliminating pollution. Investments in air and water pollution facilities have increased in recent years some five times faster than the production of pulp and paper, and it may have now reached a level of \$200,000,000 per year. The industry has now clearly passed the point where the additional cost of controlling or eliminating pollution is an economic incentive. Nevertheless, the industry complies with the pressure brought on it by the need to maintain the quality of the environment. So much so that one of the most important factors presently affecting the process, type and location of a new pulp and paper mill is its possible influence on the environment. In most parts of the world no new mills can be built without an authority from the government, which normally has special bodies to scrutinize in great detail the plans related to pollution control. The industry itself is not only fully aware and concerned with the problems of pollution but it is also supporting intensive research programmes to develop increasingly effective and economic ways of pollution control and elimination.

Recommendations to Governments on Forest Industries

(a) It is recommended that Governments should, if they have not already done so, establish minimum air, water and land pollution standards. In this connection, Governments might consider the classification of a country, or regions of a country, into well-defined zones. The minimum standards of pollution could then vary from zone to zone, depending upon the degree of urbanization and the density of population.

(b) Governments are also advised to control, through legislation, the discharge of gases, effluent or solids from forest industrial installations. Such legislation should, inter alia, prescribe minimum levels of emission for various processes, limit the allowable particulate matter discharged, and provide for the monitoring of emissions from the conversion plant.

(c) It is also recommended that Governments should establish enforcement agencies which themselves would monitor the discharge of pollutants into the environment and ensure that the laws regarding location, type of conversion plant, etc. are followed.

(d) It is suggested that Governments consider the granting of incentives to forest industry enterprises not only to encourage them to install anti-pollution equipment, but also to assist in the promotion of research into waste disposal and general pollution reduction.

(e) Governments should themselves establish Forest Industrial Pollution Research Centres which would conduct research on all aspects of forest industries pollution. These centres should evaluate the relative tolerance factors in urban and in rural areas to various types of air, water and land pollutants, and should prepare relevant environmental quality guides.

III. PROPOSALS FOR ACTION AT INTERNATIONAL LEVEL

1. WORLD FOREST APPRAISAL PROGRAMME (including forest fires)

Because of the beneficial influence of forests on the total environment, a World Forest Appraisal programme is proposed. Through this programme, the world's forest cover would be continuously monitored. This would provide an indication of global environmental stability. In particular, the balance between the world's forest biomass and the prevailing environment will be continuously measured, the quantity and quality of forest areas assessed and classified into relevant ecological groups, and changes in the forest biomass, considered as having a significant effect on the environment, will be recorded.

Data will be collected by remote-sensing techniques, through national reports, and by scanning existing inventories. The information would then be collated, computerized and analysed. An effective model would be constructed, from which caution and danger areas would be identified, and an alarm system organized for warning governments. Where, for example, the world's thermic balance is altered by the destruction of forest areas, the programme would be in a position to recognize this phenomenon and to advise on the extensive afforestation or reforestation schemes.

The programme would also coordinate information on forest destruction through fire, and research on the service and technology of forest fire prevention and control. An important feature of the programme's activities would be the detection and location of spontaneously occurring forest fires.

It is important that these investigations be carried out at the international level because (i) most of the data which the programme would collect and analyze could affect regions or the world as a whole rather than individual nations; (ii) the relatively poor communication infrastructure which exists in developing countries precludes them from anticipating and recording ecological and environmental changes in the more remote areas; and (iii) an international agency would most likely be in the best position to mobilise the resources necessary to detect and give warning about any predicted or occurred changes in the world's forest biomass that have to be prevented or corrected.

The capital costs and annual operating costs would be best established through a preliminary feasibility study which could be part of the programme. However, assuming that the collection of data is part of a broader integrated survey, capital costs are estimated at US\$ 200,000, annual operating costs being of the order of US\$ 300,000, including the forest fire unit. It is envisaged that funds would be contributed by member countries of the United Nations to that Organization, and that these funds would be disbursed by the Organization to a suitable International Agency which would execute the programme.

2. INSTITUTIONAL PROGRAMME

Another programme which is proposed is designed to provide institutional innovation in the field of environmental forestry. Such a programme would include (i) comparative studies on the influence of land tenure systems on the protective and recreational role of forests, (ii) the development and codification of an international text related to world forest protection, (iii) research on the development of public administration for environmental forestry, and (iv) the revision of current education and training programmes to accommodate new techniques for forest resource management.

Institutional factors are among the main obstacles to the proper utilization of the world's forest resources, and to a true appreciation of the importance of the influence of forests on the human environment. Most of the forest laws which are extant were conceived and enacted at a time when the full implications of the global role of forests and forestry were little understood. In addition, land-tenure systems have been evolved, which either magnified individual rights or emphasized the nation or the group within the nation. The effects of various land-tenure systems and land-use practices are often international. There therefore needs to be an international study of these systems, so that their local and global ecological effects may be impartially assessed.

Education and research methods in environmental forestry should also be revised and developed. Despite the knowledge which is now available, there is need for a new conceptual approach to the possibility of reconciling society's often conflicting demands on the forest resource. In order that these concepts may be tested and new techniques devised and implemented, more effort should be devoted to research and education.

3. INTERNATIONAL RESEARCH ON FOREST INFLUENCES

The third proposal for action at the international level concerns coordinated international research on the influence of forests on the environment. The object of this exercise would be to launch an International Research Programme which would deepen and expand our knowledge of forest ecological influences. The Programme would also define and standardize the criteria and methodology for the evaluation of forest influences in economic terms.

There is much on-going research on the forest ecological influences. However, not only a great deal of it is uncoordinated, but there are still many areas in which our knowledge is superficial. Moreover, surprisingly different results of the interplay of similar phenomena under apparently similar conditions have sometimes been obtained. Some of these disparate results, and the management conflicts which arise from them, are occasioned by differences in criteria and in methodology.

A research programme of this kind would be mainly a joint undertaking by FAO and IUFRO (the International Union of Forestry Research Organizations), especially the newly constituted IUFRO Subject Groups concerned with Ecosystems and with Environmental Influences. An inter-governmental meeting of experts would be arranged to which also representatives of UNESCO's Man and Biosphere programme, WHO, and the Use and Management Section of the International Biological Programme would be invited, for the preparation of such a research programme. This programme, when finalized, would be submitted for approval to the international agencies concerned and in particular, to the FAO Standing Committee on Forestry and to the IUFRO Executive Board, responsible for its implementation.

The launching of the international programme, including the preparation of the intergovernmental meeting of experts, would require US\$ 140,000, while the coordination of the national research programmes would require US\$ 40,000, including a meeting every two years of a coordinating council.

4. INTERNATIONAL EXCHANGE OF INFORMATION ON FOREST INDUSTRIES POLLUTION CONTROL

The final proposal is to institutionalize, under an international organization, international exchange of information on forest industries pollution control. Technical and economic data on the level of pollution caused by forest industries and on the control measures needed to secure adequate protection from such pollution would be collected by this organization and distributed to governments and industries.

This would be of particular importance to developing countries. As has been pointed out, many of these countries are anxious to establish sophisticated forest industries, and it would assist them greatly if an international organization was in a position to supply them with technical data.

ANNEX 1The Vegetation Types

As may be expected, there is, in general terms, a correlation between the climatic conditions of a particular area and the type of forest vegetation occurring there. Consequently, there is a broad correlation between latitude and type of forest. However, a rise in altitude may to some extent compensate for a low latitudinal position, and forest types which may be expected to occur in more northerly regions are sometimes found in mountainous southerly areas. Further, climate is not determined by latitude alone, and edaphic and other factors may strongly influence the vegetation.

(i) Boreal Forests ^{1/}

Evergreen coniferous forests which are adapted to areas in which there are very cold winters and relatively short growing seasons dominate the great northern belts of forest which stretch from east to west across Eurasia and North America, and extend almost to the Arctic shore in relatively sheltered areas. These northern forests are usually regarded as a single type known as the boreal forest, and consist of two separate formations: one in Eurasia and the other in North America.

The species-composition, and floristic richness of this forest type vary considerably. Thus, in the Eurasian formation there are fewer species in the European section than in the Asiatic. From western Norway to the Urals Pinus sylvestris and Picea abies dominate. However, eastwards through European Russia the frequency of other species increases and species such as Abies sibirica, Larix sibirica and Picea obovata are found. Additional species occur further eastwards.

The North American boreal forest is similar to that of Asia in the relative richness of its flora. However, there is again a gradual transition between the western and eastern parts of the formation. In the east, the dominant species are Picea glauca, Abies balsamea, Picea mariana, Larix laricina and Pinus banksiana. In the west, the eastern dominants are less frequent, and are ultimately replaced by Pinus contorta var. murrayana, Abies lasiocarpa and other species.

Distinct associations are found in the boreal forests, and there are also frequent occurrences of pure stands (consociations).

(ii) Sub-alpine forests

Because air temperatures decrease with increasing altitudes, climatic conditions on the mountain ranges of the middle latitudes may be somewhat similar to those of the boreal forest belt. Thus, evergreen coniferous forests are to be found on mountains further south than the Tropic of Cancer in both the Old and New Worlds. Some of the species of these sub-alpine zones are the same as those of the boreal forest. Generally, however, most species are quite distinct.

Pinus sylvestris, Picea abies, Larix decidua and Abies alba compose the sub-alpine forests of western and central Europe. Forests of pine and silver fir still remain between 1,500 and 2,100 m. on the Pyrenees; and throughout the Alps, spruce forest persists between 1,000 and 1,800 m. while larch and Pinus cembra form closed stands up to 2,100 m. in the central Alps. In the western Caucasus forests dominated by Picea orientalis and Abies nordmanniana are extensive between 1,500 and 2,000 m. Further east, in the Tien Shan,

^{1/} The sections devoted to temperate forests rely heavily on Eyre, S.R. (1968) Vegetation and Soils, Edward Arnold, Ltd.

Picea schrenkiana forests dominate at elevations between 1,200 and 2,200 m.

The sub-alpine forests of Europe extend southwards to the Mediterranean and even as far as the Atlas Mountains in North Africa and the mountains of southern Turkey and Syria. In Algeria and Morocco, Pinus halepensis and Abies numidica may still be found between 750 and 1,200 m. and above these, to a height of about 1,800 m. are the famous cedar forests of Cedrus atlantica. Although the cedars of Lebanon, Cedrus libani, have almost entirely disappeared from the Lebanon Mountains, they are still plentiful in the remoter areas of the Taurus.

In North America, there is an almost continuous belt of sub-alpine forests which extends along the Sierras from Canada to southern California, and along the Rockies as far south as New Mexico. Picea engelmanni and Abies lasiocarpa occur throughout, except in California, and Pinus contorta is to be found everywhere from the mountains of the Yukon to the San Pedro Martir Range in California and to the Front Ranges in Colorado.

(iii) North American Lowland and Mountain Coniferous Forests

In the past, apart from the boreal forests, there were in North America vast areas of lowland coniferous forests belonging to different formations. Much of these forests have been exploited, but large areas still remain. However, during the last two decades of the 19th century, the so-called "lake forests" which extended from Minnesota and northern Pennsylvania to southern Ontario were rapidly exploited, and to-day the vegetation of the area is generally scrub.

There still remains extensive coniferous forests in western North America. These do not fully conform to the general pattern of coniferous forests occurring at high latitudes and high altitudes. They stretch southwards from southern Alaska down the coastal lowlands as far south as California. The forests are dominated by different species in different places and are regarded as belonging to two distinct formations, each composed of a number of associations.

In the coastal lowlands of Alaska and northern British Columbia, the forest is dominated by Picea sitchensis. Southwards, in southern British Columbia and Washington, Thuja plicata and Tsuga heterophylla gradually assume dominance. Eastwards from the Cascades, these species tend to disappear and are replaced by Pinus monticola, Larix occidentalis, Abies grandis, Pinus ponderosa and P. contorta.

One larger area of coniferous forests is found in the middle latitudes, over much of the coastal plain of south-eastern U.S.A. from New Jersey southwards to northern Florida and Alabama and then westwards to Texas. Pure stands of single species are of frequent occurrence, the most common being Pinus taeda, P. echinata, P. rigida, P. palustris and P. elliotii.

(iv) Ecotone Mixed Conifer and Broad-leaved Forests

With the exception of the anomaly in western North America which has been described above, the high latitudes and high altitude coniferous forests of the northern hemisphere give way, in humid regions, to broad-leaved deciduous communities. The changes in species content are often imperceptible, in some cases the zone of transition (or ecotone) in which the conifers are intermingled with broad-leaved species is very wide, and conifers and broad-leaves occur in almost equal quantities.

In European Russia, southwards from the boreal forests, pure stands of pine and spruce become fewer and are progressively invaded by Quercus robur. Many of these forests have now been clear-felled, as the soils were found suitable for mixed farming.

The mixed conifer and broad-leaved forests of European Russia are part of a forest belt which extends across Europe. The belt begins with outliers in the Highlands of Scotland, the Massif Central and on the slopes of the Cantabrian mountains in northern Spain. It then becomes more continuous, extending eastwards from the slopes of the northern Alps, central and north-east Germany and south-central Sweden.

The mixed forest ecotone between the boreal forest and the summer deciduous forest does not reappear to any considerable extent in Asia until the middle Amur valley is reached. This type of forest is found in much of northern and eastern Manchuria, northern Korea, southern Hokkaido and northern Khabarovsk. The flora is here far richer and more varied than in Europe.

In North America also, the lake forest and the boreal forest give way to the summer deciduous forest formation through a zone of mixed forest. However, much of these forests were cleared by the early settlers and the brown forest soils utilized for crop production.

(v) Evergreen Mixed Conifer and Broad-leaved Forests

In several lowland areas of the world, there are extensive mixed (conifer and broad-leaved) evergreen forests which appear to be true climatic climax formations and not ecotone. Such forests are widespread in the southern hemisphere in South America, Australasia and southern Africa, but there are relics in the Mediterranean.

It seems clear that much of the area now cultivated, or covered with maquis in the Mediterranean was once lush mixed conifer and broadleaved forest. To-day, what remains of the original vegetation are scattered clumps and isolated individuals of Quercus ilex (e.g. in the Dardanelles in Europe and westwards from Cyrenaica in Africa), Q. suber (around the western Mediterranean basin), Pinus pinea, P. pinaster and P. halepensis.

In South America, south of the scrublands of north-central Chile, forests are first encountered at about 30°S. They are confined to the middle slopes of the western Andes between 900 and 1,300 m; the dominant species is Araucaria araucana which is found in association with Nothofagus spp., and Quillaja saponaria. On the southern part of the Brazilian Highlands, where forests occur frequently, tropical vegetation gives way to a discontinuous mixture of evergreen broadleaves and conifers. The life-form is similar to that of Chile, but the forest is less luxuriant. This type of forest appears at about 23°S at a height of about 1,200 m. and gradually extends to lower elevation southwards. Araucaria angustifolia is dominant.

Forests of very similar structure are found in the North Island of New Zealand and in eastern Australia though they have been considerably reduced. In the northern-most part of New Zealand, Agathis australis is the important tree. Mixed stands of other species which were originally interspersed with Agathis australis survive in various areas in northern New Zealand as far south as the northern and north-western coastlands of the South Island.

In southern Africa, the so-called temperate forests are now represented by mere remnants. The narrow coastal belt between Knysna and Humansdorp in South Africa is now the only area where continuous belts of these forests are to be found. Patches remain, however, between 900 and 1,200 m. on the seaward slopes of the mountains to the east and to the west.

(vi) Deciduous Summer Forest

In the past, in the lowlands of west and central Europe, large areas of broad-leaved deciduous forests were to be found. These types of forests also extended around the coastlands of the Baltic as far as the Gulf of Danzig in the south and Scania in the north. They intruded as far north as the southern coastlands of Norway and eastern Scotland, and as far south as the Cantabrian mountains, the slopes of the Ebro Lowland and the middle slopes of the Apennines and Dinaric Alps. They continued eastwards, south of the mixed coniferous

and evergreen forests, across the Danube basins, the lower slopes of the Carpathians and the Northern Ukraine.

Much of this deciduous forest has been razed to the ground. However, in the lowlands of the British Isles and France there are still some Quercus robur forests, with Fagus sylvatica and Fraxinus excelsior on the calcareous or on richer, well-drained soils. In southern Europe, there are forests of Quercus lusitanica, Q. cerris, Q. pubescens with Acer platanoides, Castanea sativa and Fraxinus ornus.

In America, the position is very much the same. Most of the deciduous summer forests have disappeared, but there are remnants of this formation which formerly formed a massive block extending from the Appalachians to beyond the Mississippi. Certain species of Quercus and Carya are still very frequent, however, while Tilia americana, Acer saccharum and Fagus grandiflora occur throughout the eastern part of the formation.

Around the Yellow Sea in western Korea, Shantung and the Kwantung Peninsula, extending into the lowlands of Hopeh, Manchuria and south-eastern USSR, the formation is also present. The dominant trees nearly all belong to the same genera as those of the corresponding forest type in Europe and North America.

In the northern hemisphere isolated stands of evergreen species such as Quercus virginiana and Magnolia grandiflora occur. They are found in Florida, on the coastal fringes of the deep south, and in north-east Mexico.

In the southern hemisphere, the essentially temperate formation type is found mainly in the South Island of New Zealand and in Australia. Along the southern part of the western coastlands of New Zealand's South Island, the windward slopes of the Southern Alps, and across the lowlands of southern Otago, the forests are dominated by Nothofagus spp. In Australia, the dominant genus is Eucalyptus.

Throughout most of tertiary times, the middle latitudes experienced much higher temperatures than they do now. They consequently supported plant communities which must have been similar to those now occupying tropical regions. Not surprisingly, therefore, many of the genera and species which are found in the temperate latitudes belong to families which are predominantly tropical. Even the coniferous species, now so poorly represented in the tropics, originated in tropical climatic conditions during Upper Palaeozoic times. The general trend therefore appears to have been the adaptation of tropical plants to cooler regions.

A series of forest types, mainly adapted to high temperatures and various humidity regimes, is to be found on all the main continents which extend into the tropics. These are described below:

(vii) Tropical Rain Forest

Wherever rainfall is heavy and reliable in the tropics, a forest type of remarkably constant structure occurs under undisturbed conditions. This tropical rain forest type comprises three formations: the American, African and Indo-Malaysian tropical rain forests.

The American formation completely occupies the Amazon Basin and extends along river valleys southwards on to the Mato Grosso, south-westwards along the sub-Andean region of central Bolivia and within Argentina, north-westwards along the foothills of the Andes in north-central Colombia and south-west Venezuela, and north-eastwards to occupy almost all of the Guianas and eastern Venezuela.

Although large areas of the African formation are still to be found in the Congo Basin and in Cameroon, much of this formation which extended in the past throughout southern West Africa has been cleared. So too has the tropical rain forest of eastern Madagascar, Mauritius and the main river valleys of south-eastern Tanzania.

The Indo-Malaysia formation is the most widely distributed of the tropical rain forests. It is found outside the Tropic of Cancer in Assam and outside the Tropic of Capricorn in southeastern Queensland; it occurs as far west as the Western Ghats in India, and as far east as Fiji. It also occurs in Malaya, Sumatra, Borneo and New Guinea.

The tropical rain forest is a closed, tall, evergreen type with trees which sometimes reach 60-70 m. Many of the trees are buttressed, and there are numerous woody epiphytes. The flora is extremely rich. In the deciduous summer forests of the U.S.A., which are considered to contain a remarkable number of species for temperate conditions, there are rarely more than twenty-five tree species to an acre. In contrast, the total number of identified species of larger trees in the Indo-Malaysian rain forest has been estimated to be as great as 3,000. The American tropical forests contain about 2,000 species of large trees. The least rich of the tropical rain forest floras is the African. But this, by temperate standards has a prodigious amount of species: just under 1,000 woody species. One significant factor about these tropical forests is that very few species, and not very many of the genera and families, are represented in all regions. As a consequence, the total tropical flora is even more complex than that found in individual continents.

(viii) Semi-evergreen seasonal forests

Tropical rain forests yield to semi-evergreen seasonal forests as the drier seasons become longer and more pronounced. The semi-evergreen forests are generally found where there is a dry season of about five months, with a mean monthly dry-season rainfall of less than 10 cm. but more than 3 cm. In this forest type, the dominants include deciduous species, but evergreens predominate. Forests of this type occur throughout the tropical world.

In the Americas, they are widespread throughout the West Indies and South America. They have been described in Trinidad, Venezuela, the interior of Guyana, and the north-eastern interior of Colombia. They form a wide belt around the southern edge of the Amazon Basin, and also run parallel to the coast of south-eastern Brazil from Recife to the southern end of the Brazilian Plateau.

In Indo-Malaysia, these forests flank the tropical rain forests in many places to the north and south. They are to be found in north-eastern India, Burma, Thailand and Indo-China, and from eastern Java to northern Australia.

In Africa, the formation is not as extensive. Perhaps the nearest approach to the types found in South America and Asia are the dry evergreen forests of West Africa which almost imperceptibly merge into the tropical rain forests.

In general, the semi-evergreen forests are poorer in floristic composition than the tropical rain forests, and the structure is less complex.

(ix) Deciduous seasonal forest

As the dry season becomes even more severe than in the semi-evergreen regions, deciduous seasonal forests occur. These plant communities are better adapted to withstand periods of drought, and although evergreens largely form the sub-dominant and lower storeys, the dominant trees are deciduous. The forests are poor in lianes and there are very few epiphytes.

These forests are found locally in Venezuela, in Guyana, in the western parts of Central America from Panama to Guatemala, and in many rain-shadow areas in the West Indies.

Much of the deciduous seasonal forests have been removed from the Asiatic-Australasian zones. However, extensive areas still remain in central Burma, Thailand and Indo-China. A similar type is also found in northern Australia.

Some stands of deciduous trees still exist over vast tracts of tropical Africa. However, there are perhaps not true seasonal deciduous forests of the types described in America, Asia and Australia. Woodland sometimes described as "dry forest", "miombo forest" or tree steppes extends from Angola across Zambia and Malawi into western and central Tanzania. Most of Katanga in the Congo and parts of the north of Rhodesia are included in this belt.

ANNEX 2Man-made Forests

In 1965 the total area of man-made forests for which figures were reported to the FAO World Symposium on Man-made Forests (Australia and New Zealand, April 1967) amounted to about 34 million hectares. Adding to these figures those areas believed to be in existence, but for which no figures were actually reported, the total area of man-made forests was reckoned to be in 1965 about 80 million hectares. This area was expected to be increased by about 5 million hectares a year over the following 20 years (about 2 million hectares in the reporting countries). Thus the total area of man-made forests should have amounted to about 100 million hectares in 1970, of which probably roughly half in China (Mainland) and the USSR (other major individual countries in this respect are the USA, Japan, Korea, Indonesia, Spain, United Kingdom and France).

As for the species planted, figures are available only for those man-made forests for which data have been reported. The picture of species composition may thus be far from representative of the true world picture if all areas could be analysed. The most widely planted group of species, though, appears to be that of the conifers: together these comprise about 70 percent of the reported plantations. The greatest proportions are in the northern temperate regions of Europe, North America and Australia. In the warmer zones of the tropics and sub-tropics the predominant species are broadleaved, but in Africa the conifers nearly match them.

With regard to species, the most important conifers are as follows:

In the colder zones: Pinus silvestris, P. koraiensis, P. tabulaeformis, P. massoniana, Picea sitohensis, Pseudotsuga menziesii, Larix spp. In the warmer zones: Pinus radiata, P. patula, P. pinaster, P. elliottii, P. merkusii, Araucaria spp. The great preponderance of pines is evident.

Of broadleaved genera and species the principal are the eucalypts (mainly E. globulus, E. camaldulensis, E. saligna/grandis), poplars (mainly P. nigra, P. deltoides and their hybrids), wattle (Acacia mearnsii) and teak (Tectona grandis). The eucalypts are probably the most extensive.

BIBLIOTECA NACIONES UNIDAS MEXICO

SEMINARIO REGIONAL LATINOAMERICANO SOBRE LOS PROBLEMAS DEL
MEDIO AMBIENTE HUMANO Y EL DESARROLLO

Organizado por la Conferencia de las Naciones Unidas sobre el
Medio Humano y la Comisión Económica para América Latina,
con el auspicio del Gobierno de México

México, D.F., 6 a 11 de septiembre de 1971

DISCURSO PRONUNCIADO POR EL SECRETARIO GENERAL DE LA CONFERENCIA
SOBRE EL MEDIO AMBIENTE HUMANO DE LAS NACIONES UNIDAS ANTE EL
SEMINARIO DEL INSTITUTO PARA ADIESTRAMIENTO E
INVESTIGACION DE LAS NACIONES UNIDAS

Las notas que aparecen a continuación están basadas en el discurso de presentación pronunciado por el señor Maurice F. Strong ante el Seminario sobre el Desarrollo y el Medio Ambiente del Instituto para Adiestramiento e Investigación de las Naciones Unidas el 24 de mayo de 1971, en la ciudad de Nueva York.

Dijo el señor Strong:

La premisa básica sobre la que quisiera hablar en estos momentos es la de que el concepto de "desarrollo" y el de "medio ambiente" no representan dos entidades separadas y distintas, sino que son manifestaciones del mismo grupo de fenómenos básicos que son las consecuencias del dominio que el hombre ha logrado sobre la ciencia y la tecnología y la aplicación de este dominio. Estos fenómenos se derivan del hecho fundamental de que el desarrollo acelerado de la ciencia y la tecnología ocurrido a raíz de la revolución industrial han producido la primera civilización tecnológica que ha habido en el mundo.

No existe ninguna definición universalmente aceptada ni de desarrollo ni de medio ambiente. Ambos conceptos se originaron dentro de márgenes mucho más estrechos que los que en la actualidad se los reconocen. En un principio el concepto de desarrollo consistía sencillamente en la consecución de capital externo y asistencia técnica para fomentar y mantener el crecimiento económico del país receptor. Más tarde se hizo evidente la necesidad de efectuar cambios básicos en las relaciones comerciales existentes entre los países menos desarrollados y las naciones industrializadas. Más recientemente todavía, la atención de los expertos ha estado enfocada sobre las implicaciones del crecimiento demográfico, el problema de administrar el desarrollo, la importancia de las diferencias existentes entre la ciencia y la tecnología de los países en desarrollo y las de los países industrializados, y sobre toda una serie de problemas que van desde el de la fuga de cerebros hasta el del papel que acompaña la inversión extranjera. Al comenzar esta segunda Década del Desarrollo, nos damos cuenta de que nuestra preocupación por el desarrollo debe abarcar todas las complejas relaciones que existen entre las regiones industriales y las menos desarrolladas.

De manera semejante, los problemas del medio ambiente se evidenciaron originalmente a raíz de los cuidados tomados por pequeños grupos de naturalistas para proteger ciertas especies de animales salvajes y conservar en su estado original los elementos del paisaje, y más tarde, por la preocupación de numerosas comunidades autónomas provocada por los problemas locales y evidentes debidos a la contaminación del agua y del aire. No es sino hasta últimas fechas que los habitantes del mundo industrial han empezado a percibir en toda su complejidad las relaciones ecológicas que están constantemente implícitas en la acción recíproca del hombre y el medio ambiente, así como la magnitud de los problemas que han creado la intervención humana en sistemas ecológicos que son elementos vitales de su bienestar, o mejor dicho de su supervivencia. La imagen más vigorosa de nuestra época es la visión de la Tierra desde el espacio exterior, una esfera increíblemente bella, finita, y vulnerable que alberga y contiene en sí todas las esperanzas de la humanidad.

Para estas fechas debe estar claro que a pesar de las diferencias que existen en el origen de nuestras respectivas disciplinas y preocupaciones por el desarrollo y el medio ambiente y las perspectivas que dichos orígenes dan a nuestros puntos de vista el objetivo fundamental de dichas disciplinas y dichas preocupaciones es el bienestar del hombre. Ya sea que tratemos de alcanzar esta meta con la bandera del desarrollo o con la del medio ambiente, la esencia común de la tarea consiste en administrar la fuerza que la ciencia y la tecnología nos brindan y aplicarlas en beneficio máximo de la humanidad.

Pero llegar a un acuerdo en este amplio objetivo es cosa mucho más sencilla que lograr comprender qué clase de acciones es la que se requiere para alcanzar esta meta y todavía más difícil es lograr organizarnos entre nosotros de manera que estemos en condiciones de efectuar dichas acciones.

Desde la época en la que el hombre primitivo descubrió el uso del fuego y construyó sus primeras armas y herramientas, las tecnologías han afectado de manera importante el medio ambiente natural. Pero la escala de las intervenciones humanas ha ido aumentando hasta llegar al punto de producir cambios extensivos y destructores en los sistemas ecológicos originales del planeta en que vivimos y que serán factores determinantes de su futuro. La esencia de este nuevo orden tecnológico tiene apenas doscientos años de existencia y sin embargo ya ha modificado la existencia humana más profundamente que cualquier otra actividad producida en la historia anterior de la humanidad. En el meollo de este nuevo orden está el conocimiento tal como lo concebía Sir Francis Bacon: "el conocimiento es poder!"

Uno de los resultados de los adelantos tecnológicos ha sido el mejoramiento drástico de la salud y la longevidad humanas. También en este caso la brecha existente entre la disminución de los índices de mortalidad y la disminución subsecuente de los índices de natalidad--que es de cincuenta años en Europa, en la América del Norte y el Japón-- ha creado otro acontecimiento sin precedentes: un aumento explosivo de la población, que podría

/resultar

resultar en poblaciones mundiales de diez mil millones en el año 2015 y de cincuenta mil millones en el de 2100. Después de tardarse cuarenta mil años para producir los primeros mil millones de habitantes, los seres humanos aumentan en esa misma cantidad cada veinte años, aunque este incremento puede lograrse para el año 2000 en sólo siete años, y en sólo cinco diez años después. Los expertos en demografía consideran que diez mil millones de "terricolas" es el número límite, si éstos han de gozar de niveles de vida modestos pero aceptables. Hay quien afirma que ya estamos llegando al límite de la población mundial que se considera propicia para lograr condiciones de vida adecuadas. No cabe duda de que cincuenta mil millones de habitantes producirán un retroceso de la humanidad y la dejarán al nivel animal de una lucha sangrienta por la supervivencia.

¿Cuáles son, entonces para la humanidad, las consecuencias de este impacto increíble de poder, producción y población? Esta es la cuestión fundamental de la crisis del medio ambiente que nos es indispensable encarar.

Esta pregunta nos obliga a comprender que cualquier sistema industrial no controlado, ya sea nacional o mundial, puede explotar de una manera tan despiadada el medio ambiente físico del hombre que los productos manufacturados, que se presentan como prueba de la elevación de los niveles de vida, están siendo producidos a costa de niveles cada vez más bajos de agua potable, aire puro, belleza natural y vida animal y vegetal, factores todos tan importantes para la supervivencia y el bienestar del hombre. En pocas palabras, el impulso de producir, igual que el impulso de fortalecer la defensa nacional, causa resultados irracionales y destructores si no es colocado bajo una dirección humana y social adecuadas.

Quisiera ahora examinar el grado en que la tecnología al servicio del nacionalismo y el comercio ha dado como resultado actual la sociedad mundial, tan desequilibrada. Quisiera examinar especialmente lo que yo considero el desequilibrio más importante de todos, la brecha que existe

entre las naciones industriales del mundo y las dos terceras partes de la población mundial que vive en países en vías de desarrollo en Africa, Asia y la América Latina. Permítaseme sugerir aquí qué es lo que ha ocurrido.

Las primeras naciones que efectuaron la transición hacia el orden tecnológico fueron, por supuesto, las de la Europa Occidental y la América del Norte. Las potencias del Atlántico empezaron a industrializarse y a urbanizarse durante el primer tercio del siglo pasado. Esta época fue, como cualquier aficionado a las novelas de Dickens y de Balzac sabe perfectamente, de dolorosos trastornos y de explotación y al mismo tiempo de creciente riqueza y de orgullo nacional. La década de 1840 fue un período en el que el hambre y el desempleo ejercieron fuertes presiones sobre la sociedad. Esta época culminó en 1848, que fue el año de las revoluciones, y muchos de los que estudiaron el orden social emergente entonces—Marx y Engels especialmente—dudaron que un sistema que contuviera en sí mismo contradicciones tan violentas estaba condenado a desaparecer.

La razón principal por la que este sistema sobrevivió fue la absorción de parte de las naciones del Atlántico de enormes riquezas y recursos, fenómeno que duró el resto del siglo XIX. Toda la superficie de tierras cultivables de clima templado de todo el mundo se abrieron al cultivo de acuerdo con métodos europeos. / Cuarenta millones de emigrantes abandonaron Europa y sus incertidumbres para emprender una nueva vida en nuevas tierras. El nuevo mundo, casi en su totalidad bajo el dominio colonial europeo constituía un territorio virgen para el comercio y la inversión en minas y plantaciones. El circuito mercantil nació gracias a las materias primas que iban hacia los países atlánticos desde la América Latina, Asia y Africa.

Esta expansión creó, por primera vez, la primera economía mundial basada en los adelantos tecnológicos. Pero también permitió que el veinte por ciento de la población del planeta, que era de raza blanca y habitaba en los países atlánticos, estuviera en condiciones de controlar un ochenta por ciento de los recursos mundiales. El impulso tecnológico, basado en la

fuerza y el capital y movido principalmente por motivos de lucro y de intereses nacionales, nos legó la economía que tenemos en la actualidad, un sistema único, cierto pero desquiciado de uno al otro extremo por los desequilibrios y las injusticias con que se distribuyen los bienes del planeta. La evolución continua de nuestra vida económica bajo el ímpetu de las tecnologías universalizadas conduce inevitablemente hacia una mayor especialización e interdependencia y por consiguiente a una mayor internacionalización.

Tampoco podemos esperar que continúe dominando sin modificación, un sistema nacional de interés y utilidades que normalice los evidentes desequilibrios. Un sistema de mercado sin correcciones, que ha operado sin tener en cuenta los imperativos sociales y sin control moral, tiene que favorecer a los poderes ya enriquecidos - en otras palabras, a los poderes que fueron coloniales, los atlánticos, a los que ahora hay que añadir a Japón. Más aún, las naciones que hoy se encuentran en vías de desarrollo, cuando tratan de ingresar al orden tecnológico, están en seria desventaja, por llegar tarde a la carrera de la modernización y porque tienen que cruzar el umbral del orden tecnológico moderno a la zaga de otras naciones más poderosas. Porque estas naciones que fueron las primeras en lograr la transición, lo hicieron construyendo un mundo económico sobre la base de sus propias necesidades, anhelos y logros. Esto se adapta muy mal a las necesidades y aspiraciones de la mayor parte de aquellas naciones que han llegado con retraso al proceso de modernización.

Cuando los gobiernos en desarrollo tratan de encontrar otras alternativas, se encuentran bloqueados por las posiciones ya tomadas por las naciones modernizadas. En cierto sentido, se puede decir que han alcanzado la etapa en que se encontraban los estados industrializados en la década de 1840. Pero en la actualidad, no disponen de grandes extensiones de tierra libre ni de mercados abiertos. No puede haber migraciones masivas. La superficie de la tierra ya está distribuida, y toda está bajo el control de otras naciones; una por una, las fronteras de las naciones más

/privilegiadas

privilegiadas se van cerrando para todos, excepto para unos cuantos elegidos entre los inmigrantes más hábiles y adiestrados. En todas partes existen restricciones artificiales para cerrar la entrada al mercado a nuevos aspirantes. Los países más industrializados controlan ya un 80 por ciento del comercio mundial y un 90 por ciento del comercio de manufactura. Y continúan manteniendo tarifas y cuotas contra los textiles exportados, vestido y maquinaria sencilla, que son las industrias incipientes que los países menos desarrollados pueden producir competentemente.

Incluso respecto a elementos tales como servicios comerciales —banca, mercado, seguros, transporte— todo el sistema está bajo el control de los países occidentales industrializados y Japón. No es fácil para un país pobre lograr su admisión, cuando llega tarde, está retrasado tecnológicamente, tiene escaso capital, cuenta con un alto índice de población, y opera siempre bajo las normas y estándares diseñados e impuestos por otros.

No es de extrañar que, aunque el medio ambiente se ha convertido con celeridad en una trascendental preocupación, tanto para el público como para los gobiernos de los países industrializados, no ha corrido esa suerte en los países en vías de desarrollo. Para muchos, el medio ambiente sigue siendo un problema de hombres ricos, una enfermedad a la que se arriesgarían si es requisito necesario para el crecimiento económico que quieren alcanzar y que tanto necesitan. Están preocupados, con razón, por la manera en que el interés de los países industrializados por el medio ambiente, afecte su principal obligación de suplir las necesidades inmediatas de su pueblo en lo que respecta a comida, habitación, trabajo, educación y cuidado de la salud. También tienen interés en que aquéllos cuyas industrias tecnológicas han producido la mayor parte de la contaminación actual, corran con los gastos procedentes de las consecuencias ambientales. Quieren estar más seguros, antes de comprometerse con entusiasmo, de cómo afectarán a sus intereses y a sus prioridades.

/Pero existe

Debe ser también evidente para los del mundo industrializado que se preocupan por la amenaza que para nuestro ambiente común representan los contaminantes que se esparcen por todo el océano y la atmósfera, que un control efectivo de esas sustancias requiere la colaboración de todos los países. ¿Cómo podemos esperar que esas gentes acepten los costos y las limitaciones que afectan su bienestar inmediato, con el simple propósito de reducir los riesgos de un futuro ya incierto y poco prometedor? De ellos sólo podemos esperar cooperación si la acción colectiva internacional toma en cuenta sus propias necesidades y prioridades. La única respuesta real y permanente al problema de administrar nuestro medio ambiente global debe basarse en la cooperación de toda la comunidad de naciones.

Esto no sería posible en un mundo en que se continúan sosteniendo las enormes desigualdades que existen entre la minoría rica, que vive en las naciones más industrializadas, y la mayoría de la población mundial que vive en los márgenes de la pobreza y desesperación en los países en vías de desarrollo. Debemos prepararnos a aceptar un sistema de poder y responsabilidad, a escala mundial, que presente un equilibrio más equitativo del ahora existente, entre la distribución de la población y sus necesidades, por un lado, y del poder económico y militar, por otro. Un sistema más adecuado de distribución de los recursos y oportunidades mundiales es requisito indispensable para lograr una comunidad mundial efectiva.

Esto sólo puede lograrse mediante la voluntad colectiva de la gente y los gobiernos del mundo industrializado, que es el más rico, el más privilegiado, el más educado y el más apto para reconocer las consecuencias de mantener nuestro actual curso. Ningún grupo que tenga un monopolio semejante de la riqueza, el poder y el privilegio, se deshará de él con facilidad. Pero no estamos hablando de entregarlo completamente, sino de compartirlo más ampliamente y utilizarlo con mayor sabiduría. Si nuestro sentido de valores morales y éticos no nos lleva a esta conclusión, un análisis objetivo de nuestros intereses, a largo plazo, lo hará.

/Los programas

1. 在 1949 年以前，中国是一个半殖民地半封建国家，政治、经济、文化各方面都受到外国势力的控制。1949 年 10 月 1 日，中华人民共和国成立，标志着中国历史进入了一个新的纪元。

2. 新中国成立后，中国共产党领导全国人民进行了土地改革、镇压反革命、抗美援朝等一系列重大斗争，巩固了新生的人民政权。

3. 1956 年，中国完成了对农业、手工业和资本主义工商业的社会主义改造，确立了社会主义制度。

4. 在社会主义建设时期，中国取得了举世瞩目的成就，如第一颗原子弹爆炸成功、人造卫星发射成功等。

5. 1978 年，中国实行改革开放政策，经济迅速发展，人民生活水平显著提高。

6. 进入 21 世纪，中国在国际事务中发挥着越来越重要的作用，综合国力不断增强。

7. 当前，中国正处于实现中华民族伟大复兴的关键时期，面临着许多机遇和挑战。

8. 中国共产党将继续领导全国人民，坚持中国特色社会主义道路，为实现中华民族伟大复兴的中国梦而努力奋斗。

9. 我们坚信，在中国共产党的领导下，中国的明天一定会更加美好。

10. 以上是中国历史发展的简要概述，希望能为您提供一些参考。

Los programas de desarrollo internacional, en su estado actual, no son sino los primeros pasos hacia la extensión en las relaciones internacionales de los principios de equidad, justicia y responsabilidad compartida que hemos llegado a aceptar como base para nuestras relaciones, dentro de las sociedades nacionales. Debemos diseñar métodos más elaborados y objetivos para transferir los recursos a países en vías de desarrollo y para mejorar su habilidad de colaborar con el mundo industrializado sobre bases más equitativas. El síndrome caritativo, fomentado por la relación donante-receptor, inherente a los programas convencionales de ayuda, ya no es una base satisfactoria y firme para las relaciones entre las naciones ricas con las pobres, de la misma manera que no lo eran, en las sociedades nacionales, entre los ricos y los pobres. Nuestra experiencia al construir nuestras sociedades nacionales demuestra claramente que no es necesario que el rico se empobrezca para que el pobre pueda mejorar sus condiciones de vida. No se trata de saber si el rico puede compartir su riqueza sino si es lo suficientemente inteligente para apreciar, a tiempo, la importancia de hacerlo así.

El impacto acelerado producido por el orden tecnológico ha hecho necesario que esta generación tome unas decisiones que determinarán, posiblemente, el curso del futuro del hombre en este planeta. Esto requiere que prestemos inmediata atención a la tarea de elaborar mejores métodos para la aplicación, tanto de los conocimientos como de los valores, a nuestras decisiones políticas y sociales, a escala mundial. Estoy convencido de que la Conferencia de las Naciones Unidas sobre el Medio Ambiente Humano deberá alentarnos, de manera decisiva hacia este objetivo. Porque nuestras esperanzas para el hombre del futuro deben descansar en nuestra confianza en que un mayor conocimiento de las consecuencias de nuestros actos producirá la voluntad y la sabiduría necesaria para hacer la selección correcta.

